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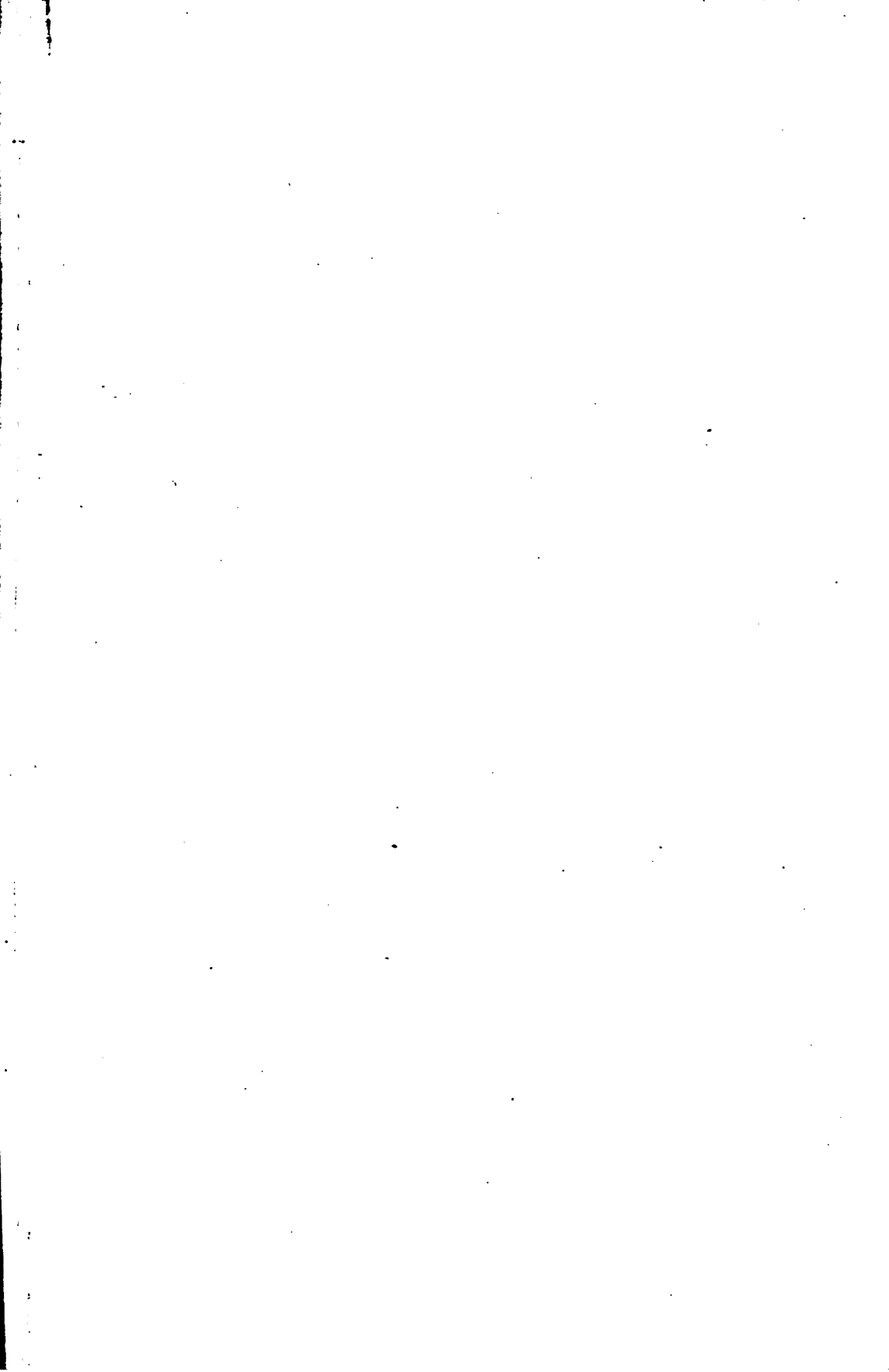
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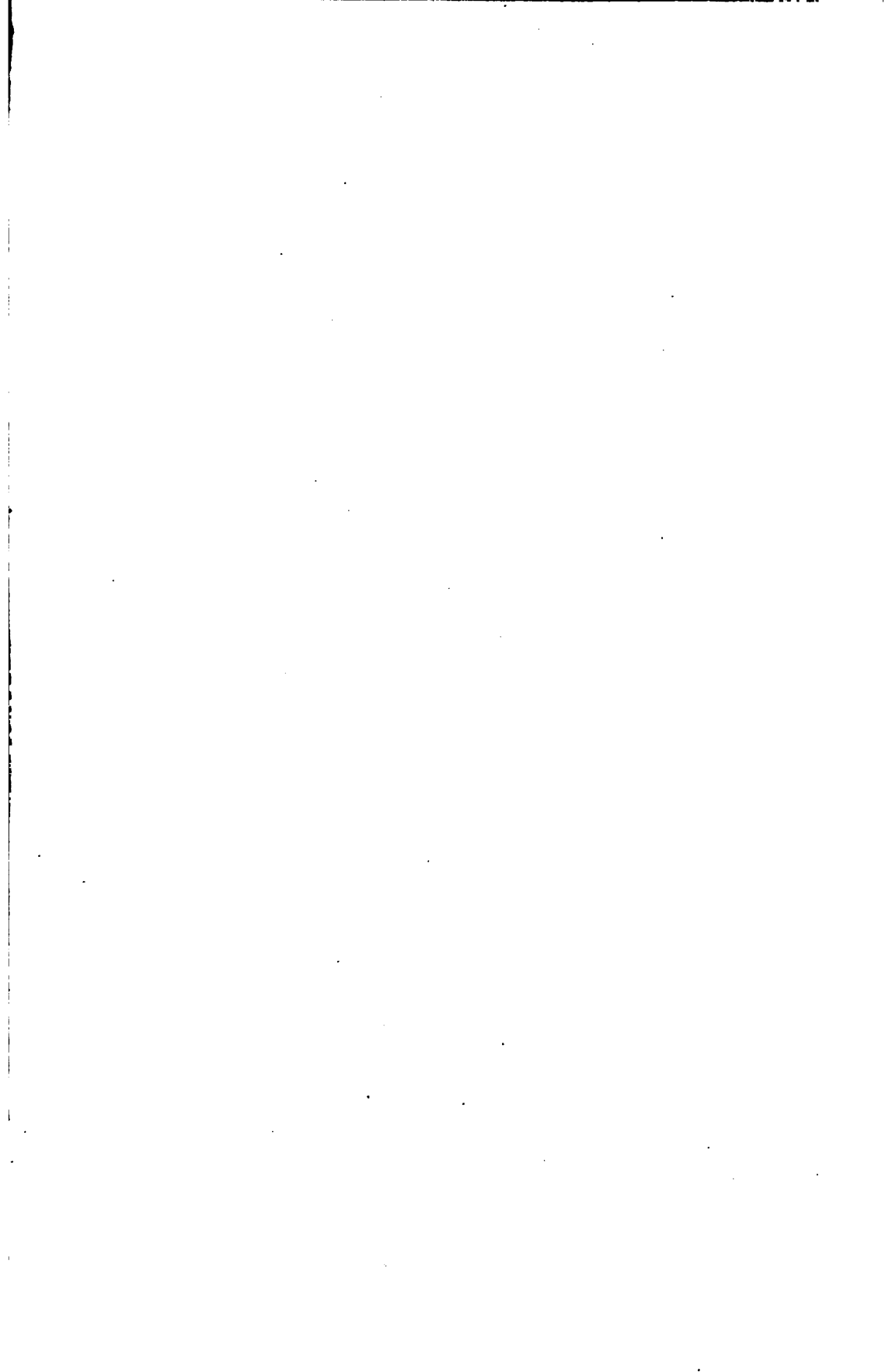
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# PROGRESSIVE MEDICINE.

A QUARTERLY DIGEST OF ADVANCES, DISCOVERIES,  
AND IMPROVEMENTS

IN THE

MEDICAL AND SURGICAL SCIENCES.

EDITED BY

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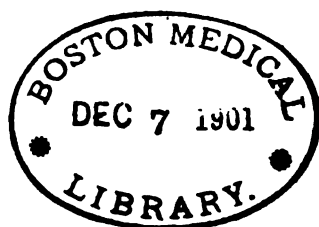
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VOLUME IV. DECEMBER, 1899.

DISEASES OF DIGESTIVE TRACT AND ALLIED ORGANS, THE LIVER, PANCREAS,  
AND PERITONEUM—GENITO-URINARY DISEASES IN THE MALE, AND  
SYPHILIS—FRACTURES, DISLOCATIONS, AMPUTATIONS, SURGERY  
OF THE EXTREMITIES, AND ORTHOPEDICS—DISEASES  
OF THE KIDNEYS—PHYSIOLOGY—ANATOMY—  
HYGIENE—PRACTICAL THERAPEUTIC  
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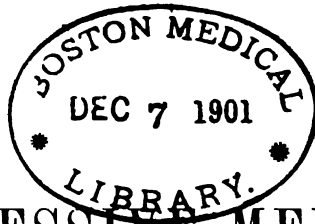


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# PROGRESSIVE MEDICINE.

DECEMBER, 1899.

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## DISEASES OF THE DIGESTIVE TRACT AND ALLIED ORGANS, THE LIVER, PANCREAS, AND PERITONEUM.

By CHARLES G. STOCKTON, M.D.

### THE ŒSOPHAGUS.

**Movements of the Œsophagus and Deglutition.** The mechanism of deglutition has been studied by W. B. Cannon and A. Moser<sup>1</sup> by means of the X-ray, using bismuth in boluses of food, blended with water, for the purpose of developing the shadow. These authors conclude that in man liquids are propelled deep into the Œsophagus, at the rate of several feet a second, by a rapid contraction of the mylohyoid muscles, but that solids and semisolids are carried slowly through the entire Œsophagus by peristalsis alone. Meltzer has shown that liquid food is not carried down the Œsophagus by peristalsis, but that, having been propelled somewhat rapidly to a point a short distance from the cardia, it is held for a few seconds, and the peristalsis, extending into the cardia, finally carries the food into the stomach.

In a recent article Meltzer<sup>2</sup> reviews the work of Mosso and Wild, as well as his own work with Kronecker, and reaffirms that the first afferent impulse is conveyed from the pharynx to the centre of deglutition, which causes a co-ordinate contraction of the mylohyoids, pharyngeal and laryngeal groups of muscles; then there follow successive afferent impulses along the several divisions of the Œsophagus, including the cardia, which cause a more or less continuous peristalsis from above downward. The fact that fluids are rapidly propelled to the lower portion of the Œsophagus, and that solids and semisolids descend more

<sup>1</sup> American Journal of Physiology, vol. i., No. 4.

<sup>2</sup> Ibid., vol. ii., No. 3.

slowly and through the intervention of marked peristalsis, is of interest in connection with functional disease of the œsophagus.

Strauss<sup>1</sup> reports an interesting case of œsophagismus apparently dependent upon disturbance of the deglutition centre. The patient was a man, aged fifty years, who died with symptoms resembling those of cancer of the œsophagus. A bougie would not pass the cardiac orifice of the stomach, and all foods were regurgitated. At the necropsy nothing whatever was found in the œsophagus to account for the obstruction, but there was present a chronic hydrocephalus internus. It should be mentioned that this case also presented all the symptoms of intestinal obstruction, in consequence of which laparotomy was twice performed, and although there was temporary improvement, nothing explaining the condition was discovered.

It occasionally happens that irritation of the mucosa of the lower end of the œsophagus or the cardia will cause œsophageal spasm. That it does not more frequently occur is probably explained by the above-mentioned experiments describing the mechanism of peristalsis. The initial stimulus to the deglutition centre comes from the pharynx, and in importance outweighs those coming from points lower down in the œsophagus. The momentary stoppage of food at the cardiac end of the œsophagus, and the appearance of peristalsis of the cardia as a final step in swallowing, indicate that this portion of the tube possesses unusual physiological activity. It is also frequently the seat of functional disturbance in dysphagia. It is not always easy to determine that the symptoms depend upon a neurosis.

**Hysterical Spasms of the Œsophagus.** This condition is sometimes produced by fright and relieved by suggestion. Cattaneo<sup>2</sup> reports an illustrative case in a child aged twelve years, who for five years had suffered from apparent stricture which followed the accidental swallowing of a glass marble. Solids were managed better than liquids, and semisolids without trouble; warm fluids were taken better than cold; free vomiting sometimes followed the attempt at swallowing. The stomach-sound was easily passed and revealed no stricture. This condition, together with other hysterical manifestations, was relieved by the passage of a sound and strong suggestion.

St. Clair Thomson<sup>3</sup> discusses functional dysphagia, and points out the danger of the diagnostic use of the œsophageal bougie in this condition. Sometimes there is aneurism, an unsuspected stricture, or some other disease of the œsophagus causing the obstruction. He accepts the pre-

<sup>1</sup> Berliner klin. Wochenschrift, September 19, 1898.

<sup>2</sup> Gazz. Degli Osped., September 4, 1898.

<sup>3</sup> London Lancet, December 6, 1898; Philadelphia Medical Journal, December 24, 1898.

vailing belief that the passage of the stomach-tube often relieves functional dysphagia, and also advises the local application of cocaine. In another place Thomson<sup>1</sup> describes two forms of functional dysphagia—a paralytic and a spasmodic form. Dr. Clifford Beale reported three cases in which patients were unable to swallow food in the presence of onlookers, but could manage it when not under observation. He also called attention to the possibility that the symptoms might arise as a result of irritation produced by some foreign body or by some point of follicular tenderness. Allusion was made to the not uncommon inability of children to swallow solids—in some cases due to adenoids, and usually dependent upon a functional neurosis.

Rosenheim<sup>2</sup> advises a 3 per cent. solution of eucaine, employed through an œsophageal syringe, for this and other conditions. In my hands the following mixture has proved more satisfactory: Orthoform, 1 c.c. (grains xv); water, 4 c.c. (1 drachm). Kassel uses orthoform in this proportion with olive oil.

**Periœsophagitis.** Considering the possibility of injury, it is remarkable that periœsophagitis is so uncommon. Huisman<sup>3</sup> reports a case of phlegmonous periœsophagitis in a patient who presented symptoms of obstruction of the œsophagus with great dyspnœa. Opposite the lower cervical vertebra was a cavity containing a purulent mass, extending into the posterior mediastinum as far as the bifurcation of the trachea. The posterior wall of the upper part of the gullet was much thickened, and at one point there was stenosis, although the mucous membrane was intact. There was purulent infiltration in the upper part of the œsophagus. This affection is said to be caused by rupture of a periœsophageal abscess into the outer layers of the tube. Small abscesses have been found in the œsophagus in phthisis. In this case there was found also tubercular infiltration in the apices of both lungs, and it is believed that the œsophagus was involved secondarily. Such a process as this may heal after rupture into the gullet, and a diverticulum may result. The diagnosis of periœsophagitis is rarely made during life, but it is believed that the signs of obstruction and pain in passing the tube, together with examinations of the blood, would at least suggest a correct diagnosis.

**Deformity of the Œsophagus.** T. W. Griffith<sup>4</sup> reports a case of fusiform dilatation of the œsophagus unassociated with organic stenosis. The pathogenesis of this condition is not always clear. Griffith supposes that it does not altogether lie in simple atony nor hypertrophy of the

<sup>1</sup> Harveian Society, London, November 17, 1898; *British Medical Journal*, November 26, 1898.

<sup>2</sup> *Berliner klin. Wochenschrift*, 1899, No. 4.

<sup>3</sup> *Deutsche med. Wochenschrift*, April 27, 1899.

<sup>4</sup> *Medical Chronicle*, November 2, 1898.

muscles, nor in spasm, but that a certain degree of inactive pressure in the mediastinum, probably from inelasticity of the lung, is exercised. For treatment he recommends galvanism, and it is important to prevent the accumulation of solid particles of food that may not be carried down in the absence of peristalsis. The same objection does not hold for semisolids and liquids.

**Œsophageal Pouch.** An interesting instance of this affection is described by Wright and Smith.<sup>1</sup> It occurred in a man, forty-five years old, who had suffered from the disease for ten years. He swallowed slowly, and, after eating, depression of the head led to the return of food, which was sometimes frothy, but never sour. At the beginning of the meal he found it difficult to swallow solids. By pressure on the right side of the neck above the sternoclavicular articulation, food could be forced upward into the mouth, and sometimes air, accompanied with a squeaking sound. This occasionally happened with food taken twelve hours before. After drinking, gas and fluid could be returned by pressure on the neck. These symptoms might suggest an œsophageal tracheal fistula, in which case it would be well to remember Kohlenberg's method of diagnosis. The latter introduced a soft stomach-tube, so that its lower end passed slowly from point to point along the œsophagus. At the proximal opening of the tube a candle-flame was placed. In health the flame is aspirated during inspiration, and blown away during expiration, but when the stomach-tube reaches the fistulous opening the flame is continuously blown outward during both inspiration and expiration. The correctness of this theory has been verified by autopsy.

The various means of differentiating between a diverticulum of the œsophagus and diffuse dilatation of the gullet are well rehearsed by Reitzenstein:<sup>2</sup> First, failure of the sound to pass into the stomach after steady, gentle pressure for a considerable time indicates diverticulum. Second, the chemical examination of the contents, showing the absence of hydrochloric acid or gastric ferments, points to diverticulum, as also does the finding in the contents of portions of previous meals, while the succeeding meal has passed smoothly into the stomach. Third, if there is passed into the stomach a tube, the sides of which are fenestrated to a point high enough to be in contact with the diverticulum, and a second tube is passed beside this, and water is poured into the second tube, as much water as was introduced may be siphoned off. If, on the contrary, there is no diverticulum, but diffuse dilatation, not a drop will return. Fourth, by passing one stomach-tube into the diverticulum and the other into the stomach, and using different colored fluids, it may be demon-

<sup>1</sup> British Medical Journal, April 9, 1898.

<sup>2</sup> Centralblatt für Chirurgie, July 16, 1898.

strated that the tubes are in different cavities. Fifth, transillumination by the gastrodiaaphane. Sixth, using the X-ray after a bismuth mixture has been swallowed or after the introduction of a shot-filled stomach-tube. I. Landauer<sup>1</sup> describes a very deep-seated diverticulum, of which he was able to make a diagnosis in this way. Similar cases have been reported by Miritz, Reichmann, and Reitzenstein. Other methods are mentioned that are of secondary importance.

**Stenosis of the Œsophagus.** Œsophageal stricture resulting from the swallowing of caustics is sufficiently frequent. Barling<sup>2</sup> presented a patient, two years old, in whom stricture followed the taking of sulphuric acid. Dilatation of the Œsophagus followed, but the trouble was relieved by the simple passage of the sound. Roemheld<sup>3</sup> reports a similar case in a boy, aged four years, who was relieved, after the performance of gastrostomy, by a retrograde dilatation of the Œsophagus by means of conical bougies carried through the fistula. A remarkable case of stenosis of the Œsophagus, which followed severe ulceration produced by scarlet fever, is reported. The stricture was located 18 to 20 cm. from the incisor teeth. Here also gastrostomy was performed and retrograde dilatation was carried out, but with only partial success. An attempt to dilate by Koenig's method, using a string of beads, was also unsuccessful; the spiral sound was tried and failed, and a laminaria tent somewhat relieved the stenosis. Ultimately the stricture was overcome by the passage of sounds; a diameter of 12 mm. was obtained, after which the fistula was closed and the child recovered. Stricture of the Œsophagus sometimes follows syphilis, but as a cause it must be considered rather rare. N. Pries<sup>4</sup> describes a case that was relieved by mercurial inunctions and other specific treatment.

**Cancer of the Œsophagus** is frequent, and is most often seen in the region of the cricoid, or near the cardiac orifice of the stomach. Hitzig<sup>5</sup> reports having discovered inequality of the pupils in six out of thirty-seven cases of Œsophageal carcinoma, doubtless from involvement of the sympathetic. Why this should have occurred in 17 per cent. of the cases is difficult to explain; but the association of the two it is well to bear in mind.

## THE STOMACH.

**Innervation of the Stomach.** The difficult subject of gastric innervation has been studied by Courtade and Guyon; their results have been

<sup>1</sup> Centralbl. für innere Med., 1899, No. 16.

<sup>2</sup> British Medical Journal, December 24, 1898.

<sup>3</sup> Münch. med. Wochenschrift, 1898, No. 46.

<sup>4</sup> Medicina, T. X., 1898, No. 43.

<sup>5</sup> Deutsche med. Wochenschrift, September 2, 1897.

reported in contributions to the Société de Biologie,<sup>1</sup> in which evidence is offered that there is an antagonism between the pneumogastric and the great splanchnic nerves. They believe that excitation of the pneumogastric provokes contraction of the longitudinal, and later of the circular muscular fibres—in other words, increases peristaltic movements of the stomach—while stimulation of the great sympathetic nerves antagonizes peristaltic movements and causes constriction of the circular and relaxation of the longitudinal fibres. The pneumogastric is believed to act upon the pylorus in such a manner as to provoke evacuation. The great sympathetic tends to tighten the pyloric passage and arrest motor function. The great sympathetic and splanchnics dilate the cardia, while the pneumogastric contracts it. The antagonism between these nerve-supplies shows an action parallel to that seen in the nerves of the intestine and bladder.

At the Seventeenth German Congress of Internal Medicine, held at Carlsbad, in April, 1899, Von Mering and Aldehoff<sup>2</sup> reported the results of a series of experiments upon animals, in which they concluded that neither the vagus, the celiac plexus, nor the splanchnic has any apparent effect upon either motility or secretion of the stomach. They concluded that the ganglion cells lying within the walls of the stomach are the nerve-centres from which these functions arise. Nevertheless, they believe that these centres are under control of the central nervous system, as physiological and clinical experience indicates. Personal experimentation convinced me that stimulation of the pneumogastric nerves constricts the pylorus and produces no other appreciable effect upon the gastric motility. These views are confirmed by the elaborate experiments of Meltzer.<sup>3</sup>

**Electro-therapeutics in Gastric Diseases.** Einhorn and Hemmeter believe that they have excited gastric motility by electrical stimulation of the gastric mucosa, a result which neither Meltzer nor I could obtain. There is ample clinical experience to warrant the intragastric application of electricity to improve both the motion and secretion of the stomach, but physiological experiments so far have not satisfactorily explained these results. In discussing this subject, Clifford Allbutt<sup>4</sup> deprecated the advantages of electricity. Herschell replied with the statement that there was overwhelming clinical evidence in favor of the method. We should conclude that electricity has secured a position in the therapeutics of gastric diseases, but that so far it can be positively defended from clinical experience alone.

<sup>1</sup> Bulletin Médical, March 23, 1898, and July 28, 1898.

<sup>2</sup> Reported in Wiener med. Blatter, 1899, No. 18.

<sup>3</sup> Transactions Association of American Physicians, 1898, vol. xiii.

<sup>4</sup> British Medical Journal, July 28, 1898.



**Gastric Secretion and Digestive Ferments.** Camus and Gley<sup>1</sup> have made an interesting but complicated report of their experiments with pepsin, lab-ferment, and trypsin. Linossier<sup>2</sup> has made a report on digestive ferments that led to an interesting discussion, in which Soulier, while believing that the stomach plays an important rôle in digestion, gave expression to the old skepticism as to the usefulness of pepsin. He believed, with Germain Seé, that there is always sufficient pepsin secreted for the requirements of digestion. Linossier, disagreeing with this dogma, held that pepsin is in itself useful, and suspension of its secretion means impaired digestion, and said that pepsin does more than to initiate the digestive act. Dufourt thought that pancreatic juice would take care of the ailments regardless of the gastric digestion. In reply, Linossier stated that this is not found to be the case in experimentation with animals. It is safe to conclude that Linossier is correct in his views. While it is useless to administer pepsin with a view of restoring gastric function, there is reason to believe that its presence is very necessary to the well-being of the patient. Its exact rôle in the present state of our knowledge is not easy to explain; but it should not be discarded so generally as has been recommended in recent literature.

Much discussion has arisen as to our resources for the increase of gastric secretion by means of the administration of drugs. To answer this question, Fremont<sup>3</sup> experimented on dogs, freeing the stomach from the œsophagus and intestine. The gastric juice was studied from the stomach thus isolated. Subsequently there was introduced a variety of substances, and the relation of the total acidity to the total chlorides was studied. He found that both the total free acid and total chlorides were increased by the following drugs, the activity of which is in the order mentioned: White wine, gentian, condurango, cardui benedicti, hops, simaruba, menyanthes, colombo, quassia, strychnine, and pilocarpine. White wine more than quadrupled the total acidity and more than doubled the total chlorides; gentian and condurango followed closely after; pilocarpine increased the total acidity only 7 per cent., and strychnine only 43 per cent. These figures are something of a surprise, and are not in accord with the usual clinical experience which has credited strychnine and pilocarpine with a much higher place than that occupied by white wine or gentian. Fremont's views agree in the main with the experimental results of Olivetti and Maggia,<sup>4</sup> who found that although pilocarpine temporarily increases appetite, it does not excite an increase of free hydrochloric acid in case of subacidity. At the last (Carlsbad)

<sup>1</sup> Arch. de Physiologie, 1897, No. 4.

<sup>2</sup> Ibid., September 4, 1898, No. 36.

<sup>3</sup> Lyon Medical, January 22, 1899, No. 4.

<sup>4</sup> Cited in Il Morgagni, 2, No. 44.

meeting of the German Congress of Internal Medicine, Riegel reported that in a series of experiments on animals he was unable to demonstrate an invariable result of any one drug upon gastric secretion. Generally atropine depressed the secretion, the free hydrochloric acid falling to one-half or one-third the normal. On the other hand, the acidity was equally increased by the hypodermatic use of pilocarpine. The disturbance of gastric motility may have played a part in determining the result in the above-named observations. When, through faulty motion, the acid chyme is not discharged into the intestine, hyperacidity results.

The effect of motion in promoting chemical changes in the stomach contents has been recently studied by Turck,<sup>1</sup> who, in a preliminary report, has shown that in the artificial stomach the addition of regular churning movements materially advanced the digestive process.

**Acute Catarrhal Gastritis.** Some sensible remarks on this disease and on its management are made by Boardman Reed,<sup>2</sup> in which he calls attention to the fact that acute febrile catarrh of the stomach is uncommon in the adult, though so frequent in children. He points out that the well-known symptoms are closely simulated by vomiting, associated with gastralgia, dependent upon nervous disturbance. This observation should be emphasized, as this error in diagnosis is frequently made. In gastritis there is always tenderness on deep pressure. Superficial tenderness is more common in the neuroses and is dependent upon hyperæsthesia. The presence of hyperæsthesia in other regions and the accompanying evidences of nervous irritability assist in making the distinction.

The indications for treatment are, first, removal of any remaining particles of gastric contents; second, rest of the inflamed organ. This practically completes the treatment. Reed advises against allowing large draughts of cold water, especially when acidulated; against the urging of food upon the patient, whereas fasting is desirable, and against the administration of antiemetics, such as bismuth. Calomel in small, frequent doses he advises, and he speaks of personal success in the use of arsenite of copper in doses of  $\frac{1}{1000}$  of a grain. In alcoholic gastritis he prefers the copper arsenite to the old favorite—Fowler's solution. Personally, I have had no success with this use of copper. The calomel should be given in sufficient amount to thoroughly empty the gastro-intestinal tract.

**Chronic Catarrhal Gastritis.** A long and critical review of this subject comes from Bruno Oppler.<sup>3</sup> The disease may occur as a primary or secondary manifestation. In all the pathological changes are similar.

<sup>1</sup> Journal of American Medical Association, June 24, 1899.

<sup>2</sup> International Medical Magazine, April, 1899.

<sup>3</sup> Klin. Vorträge, September, 1898, Heft 123.

The gross appearance of the mucous membrane is that of thickening and looseness of structure, with a reddish-pink or grayish-pink color, depending upon the stage of the disease, with a covering of stringy mucus, sometimes milky in appearance, due to leucocytes and degenerated epithelium. The thickening is irregular in distribution and the underlying submucosa forms the picture of the so-called "état mamelon." Sometimes there are evidences of polypus-like growths; again, there are catarrhal erosions which may extend to true ulceration. Microscopically there are evidences of congestion, which may extend to the muscularis. The hypertrophy and thickening may give rise to stenosis of the pylorus. The secreting glands may disappear and be replaced by mucous membrane. The condition known as cirrhosis ventriculi results from marked thickening from increase of interstitial tissue. Under such conditions the stomach may retain its normal size and present few gross changes. The author takes up the symptomatology, which includes few items of diagnostic importance, as most of these may be produced by other conditions. The appearance in the stomach contents of the mucus above described is a valuable symptom. The secretion of free hydrochloric acid is generally decreased. In the beginning of the disease it is in some instances increased—a fact that has attracted much attention in France, where its importance seems to have been exaggerated. The differential diagnosis between functional affections of the stomach and chronic catarrhal gastritis is sometimes difficult, although examination of the gastric contents and the study of the case, both as to etiology and progress, enable one to reach a correct conclusion. Chronic catarrhal gastritis is very often secondary to diseases producing passive congestion of the stomach and other abdominal viscera. It is, therefore, commonly seen in those affections of the heart, lungs, and liver that obstruct the circulation of the blood. Aside from such cases, contrary to the accepted belief, it is not a very frequent affection, and the majority of cases treated for chronic catarrhal gastritis are essentially cases of neurosis, gastropotosis, or gastroectasis.

A form of the disease called ATROPHIC CATARRHAL GASTRITIS has recently attracted considerable attention. The subject has been well treated by A. Reichmann,<sup>1</sup> of Warsaw. The striking feature of this form of the disease is the disappearance of gastric secretion, for which reason the affection is constantly confused with *achylia gastrica*, which is, at least in the beginning, often merely a functional affection. Reichmann speaks of the symptoms as appearing suddenly and usually on alternate days, not immediately after meals, but generally during the night. First there is nausea; second, painful sensations like those resulting from

<sup>1</sup> Berliner med. Wochenschrift, 1898, No. 48; La Semaine Médicale, 1898, p. 464.

enteroptosis; third, regurgitation of an alkaline-saline liquid containing no true gastric juice. The fluid obtained from the stomach appears to be a watery secretion of the mucous membrane, and exercises no digestive action either on starchy or nitrogenous foods. For treatment, he recommends lavage and the administration of extract of pancreas, and, at other intervals, hydrochloric acid.

There is no doubt that atrophic gastritis has a real existence, but many observers who have studied the subject carefully believe that the condition often begins as a functional *achylia gastrica*, with the atrophy appearing as a secondary matter.

**TREATMENT.** Caporali,<sup>1</sup> for chronic catarrhal gastritis, recommends lavage with a solution of zinc sulphate, 0.01 to 0.02 centigramme to the litre of water, and later the strength may be somewhat increased. A weak solution of sodium bicarbonate, which converts the remaining portion of the zinc sulphate into zinc carbonate, should be administered immediately after. This plan of treatment seems to particularly suit some cases, but in my practice it has not generally supplanted silver and the vegetable astringents, such as hydrastis and hamamelis.

**Erosions of the Gastric Mucous Membrane.** This condition, first described by Max Einhorn,<sup>2</sup> he has again reviewed, and he reports thirteen new cases. He answers Hemmeter and others, who believe that the erosions are merely a feature of chronic gastritis, and refers to the writings of C. Pariser, Stockton, and Allen Jones as supporting his own views on the nature of the disease. Einhorn's position is apparently well taken, although it must be confessed that the etiology of the disease is very obscure. For treatment, he repeats the recommendations made in his former articles<sup>3</sup> and in his text-book.

**Peptic Ulcer.** Berg<sup>4</sup> advances a new theory to explain the development of peptic ulcer. He supposes that it results from a narrowing of the pylorus, which leads to a certain amount of food stagnation, which is followed by increased acidity and chronic gastric catarrh. Basing his therapy upon this theory, he advises as treatment gastric lavage and the relief of food stagnation. Here the writer apparently fails to recognize the importance of the fact that lavage immediately preceding or during the development of gastric ulcer does not reveal food stagnation, except when the ulcer is at the pylorus, when it would naturally cause obstruction, contraction, or spasm. Nor does he give sufficient importance to the fact that at necropsy peptic ulcer shows a singular absence of accompanying inflammatory processes.

<sup>1</sup> Bulletin Médical, 1899, No. 16.

<sup>2</sup> Journal of American Medical Association, May 20, 1899.

<sup>3</sup> New York Medical Journal, September, 1892.

<sup>4</sup> Medical Record, July 30, 1898.

Gaston Lyon,<sup>1</sup> after reviewing the etiology, believes that we must admit the association of these two factors: First, lesion of the mucosa; second, the corrosive action of the acid gastric juice on the mucosa and its consequent interference with cicatrization.

AufRAY<sup>2</sup> gives the following rules for the recognition of perforation of the stomach in gastric ulcer: The appearance of sudden, intense, localized, almost continuous pain, which increases with the ingestion of food. He would regard this as the best diagnostic evidence, but there also would likely appear an unusual tension of the abdomen with resistance and retraction of its walls; also rapid and severe collapse, with absence of vomiting and fever. With the performance of laparotomy, the escape of gas and the presence of partly digested food without fecal odor confirm the diagnosis.

Cabot<sup>3</sup> reports a case of perforation in which the abdomen was filled with gas, but no gastric contents nor any secretion had escaped.

Several instances of round ulcer without hyperchlorhydria have been reported. An interesting instance is given by Anton Krokiewicz,<sup>4</sup> which is the second he has reported. At first the hydrochloric acid was free in the gastric contents, but disappeared, to give place to lactic acid. There was moderate leucocytosis and 70 per cent. of hæmoglobin, but this was following hæmatemesis. A diagnosis of latent cancer was made, but at autopsy thirty ulcers were found in the mucous membrane of the stomach and no malignant disease. It should be noted that the mesenteric and retroperitoneal glands showed caseous degeneration, and there was found pulmonary tuberculosis. The author concludes that the disappearance of free hydrochloric acid may occur shortly before death. He points out the fact that there were 4,000,000 red cells to the cubic millimetre, which should be taken as an evidence against carcinoma. It is possible that the ulcers in this case were of tubercular origin—a fact which might have a bearing upon the absence of free hydrochloric acid.

According to J. Petruschky,<sup>5</sup> it is impossible to diagnosticate a tubercular gastric ulcer bacteriologically, because of the manifest sources of error. He has succeeded in making a diagnosis twice by means of the tuberculin test. He reports two cases thus recognized, in one of which a cure was produced by the use of tuberculin, other treatment for the condition having been tried for some years without success. R. Schütz<sup>6</sup> finds that certain affections of the large intestines—for instance catarrhal

<sup>1</sup> Bulletin Médical, 1898, No. 25.

<sup>2</sup> Gaz. heb. de Med. et de Chir., September 8, 1898.

<sup>3</sup> Boston Medical and Surgical Journal, August 11, 1898.

<sup>4</sup> Wien. klin. med. Wochenschrift, December 1, 1898.

<sup>5</sup> Deutsche med. Wochenschrift, 1899, No. 22.

<sup>6</sup> German Congress of Internal Medicine, 1899. Reported in Münch. med. Wochenschrift, May 9, 1899, No. 18.

inflammations, enteroptosis, and obstipation—may simulate very closely the picture of gastric ulcer. He finds that these cases are relieved by clearing the colon by lavage, which enables one to exclude gastric ulcer. Surely such cases must be very exceptional.

We may still hold to the belief that in gastric ulcer hypersecretion is the almost invariable rule. According to Fremont,<sup>1</sup> the secretion of hyperacid gastric juice is continuous and not intermittent, and it requires to be continuously neutralized. For this purpose he would employ large doses of alkalis, given in portions of milk every half hour. He believes that to nourish per rectum in case of peptic ulcer is a deplorable practice, and especially advises against ice or cold milk, although ice-packs over the abdomen have a favorable effect.

Gaston Lyon<sup>2</sup> says that it remains for Fremont to prove what he says as to the continuous secretion of gastric juice—a statement that he regards absolutely in discord with accepted ideas. He also objects to the administration of aliments by the mouth, and believes that the best way to suppress hydrochloric acid secretion is to abandon the causes that excite the secretion, the most important of which is the ingestion of food. Lyon<sup>3</sup> believes that gastric ulcer is amenable to a purely medical treatment, save when there is rapidly mortal or continued hemorrhage, or when there are continued excruciating pain and incoercible vomiting or intercurrent perforation. As indications for treatment, he would place, first, measures directed toward the cicatrization of the ulcer. Here rest of the organ is of first importance; but by that he does not mean prolonged rectal alimentation; this he would employ only during a very limited time when there has existed prolonged hæmatemesis or incoercible vomiting and violent pain. He would employ a diet of skimmed milk, beginning with one-half glass every three hours, and slowly increasing it until there is taken a glassful every two hours. For rectal alimentation, milk with the yolk of eggs is advised, to which should be added salt. He thinks rest in bed should be prescribed for two or three weeks at least, and he recommends the administration of subnitrate of bismuth in doses of 10 to 15 grammes suspended in 200 grammes of water. This treatment, with large doses of bismuth, was suggested some years ago by Fleiner, by whom it was sometimes introduced through the stomach-tube. Dreschfeld, of Manchester, believes in the bismuth, but objects to the use of the tube. Lyon believes that the bismuth assists in suppressing pain and vomiting, and favors the cicatrization of the ulcer, but that, contrary to the assertion of Fleiner, it has no action upon hyperchlorhydria. There can be no doubt but that bismuth is much

<sup>1</sup> Bulletin Médical, June 22, 1898, No. 50.

<sup>2</sup> Ibid., June 26, 1898, No. 51.

<sup>3</sup> Ibid., 1898, No. 25.

more serviceable when used in a previously emptied stomach, although the practice of lavage is attended with some risk in gastric ulcer.

Lyon's second indication for treatment is to remove the hyperchlorhydria. For this he would employ hot fomentations over the epigastrium and the use of Carlsbad salts, as recommended by Leube. He advises alkalies in the form of sodium bicarbonate in doses of 10 to 30 grammes in twenty-four hours. This he regards as a mere palliative, and in no sense as specific. Other alkalies, such as chalk and magnesia, may be used in combination. In discussing these views of Lyon, Mathieu<sup>1</sup> expressed his disapproval of the use of the stomach-tube, except in cases of chronic ulcer with obstruction. Each time that an acute attack occurs he would nourish the patient per rectum. On the first day he advises several injections of salt-water, from 200 to 300 c.c., as a means of sustaining the patient and rendering the rectum accustomed to the work imposed upon it. Later, to the salt-water should be added an egg, and ultimately the salt-water should be replaced by milk. The Carlsbad cure is not believed to decrease hydrochloric acid secretion, and it should not be employed during the active period of the disease. Mathieu also objects to the use of iron and arsenic for the relief of anæmia until after the ulcer is healed. The views of Mathieu are as sound as they are simple. Ewald<sup>2</sup> treats cases of active ulcer by rest in bed, nutritive enemata, pellets of ice in the mouth, and a few drops of cocaine solution, to relieve the sense of hunger.

**Gastrorrhagia.** Successful methods for the treatment of gastrorrhagia continue to appear. Possibly the fact that it is natural for arterial hemorrhages to cease when the blood-pressure becomes low is too much overlooked. Winternitz recommends the introduction of ice per rectum, which is supposed to act reflexly in contracting the gastric bloodvessels. Ice applied to the testicles is supposed to control hæmoptysis through a similar action. Prof. Tripier,<sup>3</sup> of Lyon, on the other hand, recommends the injection of water at a temperature of 50° C. per rectum, three times a day, and oftener if there is hemorrhage. Editorially, the *Lyon Medical*<sup>4</sup> recurs to the subject, reporting a grave case in which the treatment proved most successful. J. G. Ziarko,<sup>5</sup> after examining ten cases, shows that, in contraindication to the observation of Winternitz, the acidity of the gastric juice is diminished after the use of nutritive enemata, and, therefore, they are to be recommended after hemorrhage from gastric ulcer. A similar plan is advocated by Lépine.<sup>6</sup> Recently, gelatin in 10 per cent. solution has been employed for the relief of gas-

<sup>1</sup> Bulletin Médical, 1898, No. 43.

<sup>2</sup> Transactions British Medical Association, Edinburgh meeting, July, 1898.

<sup>3</sup> Lyon Medical, July 17, 1898, No. 29.

<sup>4</sup> Ibid., January, 1899, No. 1.

<sup>5</sup> Prag. med. Wochenschrift, 1899, No. 14.

<sup>6</sup> Thèse de Lyon, 1899.

tric hemorrhage after the failure of other means of treatment. Poliakow<sup>1</sup> recommends about 200 c.c. of this solution to be taken three times a day.

We must remember that gastrorrhagia is not always occasioned by gastric ulcer. Cipriani<sup>2</sup> reports an instance of gastric hemorrhage occurring in a chlorotic. In this case, after the failure of other measures, the hæmatemesis was promptly arrested by compressing bandages applied around the body and over the stomach, with which rectal alimentation was combined. Thirst was relieved by injections of salt solution and hunger by subcutaneous injections of cocaine. Eder<sup>3</sup> reports the case of a colored woman, twenty years old, who had vomited blood once or twice a day for over a year. The quantity was not over half a wineglassful. There was no intestinal bleeding, no digestive disturbance, and menstruation was regular. She was not anæmic nor were there any other abnormalities found, save a ragged ulcer in the nasal passages, from which a slight amount of blood oozed. After this spot was cauterized the hæmatemesis ceased, although it was not thought that the blood came from the nose.

Steven<sup>4</sup> reports the case of a woman, twenty-six years old, who was in perfect health until the present attack, which began with anorexia and pain after taking food. She soon had profuse vomiting of blood, and died from an uncontrollable diarrhœa. On post-mortem there was found on the posterior surface of the stomach, four inches above the pylorus and slightly below the lesser curvature, an abraded area which was superficial and one-fourth by one-eighth inch in size. Near its centre were two pinhole openings leading directly into one of the lateral branches of the gastric artery. In a second very similar case a superficial abrasion occurred near the pylorus, slightly above the greater curvature. In the centre there was a small opening leading into each branch of the gastro-epiploic artery, and in this case hemorrhage was profuse. There was an absence of the usual gastric symptoms in stomach disease.

According to Dreschfeld,<sup>5</sup> gastric hemorrhage may be due to toxic gastritis, carcinoma, persistent vomiting, the various affections leading to portal obstruction and to alterations in the blood, as in leukæmia, jaundice, pernicious anæmia, purpura, hæmophilia, and scurvy; also occasionally from functional nervous causes, and, as a rare occurrence, vicarious menstruation. Among the new remedies for the treatment of gastric ulcer is potassium bichromate, in doses of one-tenth to one-twelfth of a

<sup>1</sup> Lyon Medical, 1898, No. 38.

<sup>2</sup> La Semaine Médicale, April 27, 1899.

<sup>3</sup> London Lancet, February 18, 1898.

<sup>4</sup> Glasgow Medical Journal, January, 1899; British Medical Journal, February 4, 1899.

<sup>5</sup> British Medical Journal, January 7, 1899.



grain every six hours, recommended by McHardy.<sup>1</sup> Maberly<sup>2</sup> speaks of two South African drugs, *Monsonia ovata* and *Monsonia burkei*, for the relief of gastric ulcer and ulcer of the upper intestinal tract.

The gravity of the prognosis in round ulcer of the duodenum is referred to by Burwinkel,<sup>3</sup> although he reports five cases that recovered. He rehearses the following points of diagnosis: First, melæna, showing that the blood came either through the stomach or duodenum, and the absence of hæmatemesis, leading to the belief that the stomach was not the seat of hemorrhage; second, the seat of pain corresponding with the duodenum and appearing two or three hours after food; third, previous dyspeptic symptoms; fourth, age and sex. The patients are nearly always men at about middle life.

**Cancer of the Stomach.** To our knowledge of cancer of the stomach, Cheney<sup>4</sup> has added the reports of examinations of 150 cases, 20 of which occurred in subjects under thirty years and 17 between the thirtieth and fortieth years of age. Only 11 out of 150 cases presented a family history of cancer. Pain was present in 130, vomiting in 128, tumor in 115, hæmatemesis in only 36, aggravated dyspepsia in 38. He calls attention to the established fact that tumor of the pylorus may be found in almost any part of the abdomen, and he highly recommends inflation of the stomach as an assistance in diagnosis. Statistics showing that cancer occurs more often in men than in women are accumulating. Emile Larié<sup>5</sup> presents two series of cases showing that this preponderance of the disease in males holds true in France.

Cancer may exist as a comparatively latent affection, as shown in an article by J. Friedenwald.<sup>6</sup> He reports the case of a man, seventy years old, who at no time complained of feeling ill, and who died suddenly from hemorrhage, the result of an adenocarcinoma occupying both the anterior and posterior walls of the stomach. The lack of differential symptoms and signs in carcinoma ventriculi is dwelt upon by C. W. Dulin,<sup>7</sup> who says that the symptoms of cancer may be paralleled in chronic catarrhal gastritis, gastric ulcer, gastric neuroses, or dilated stomach. A. Gordon<sup>8</sup> holds that there are no pathognomonic symptoms known of this disease. The coexistence of chronic gastritis of a depressed type, and lactic acid in the stomach contents—although either condition may exist separately—is important evidence of cancer. The appearance of a tumor, he considers, usually occurs too late to render it

<sup>1</sup> Scottish Medical and Surgical Journal, December, 1898.

<sup>2</sup> London Lancet, July 16, 1898.

<sup>3</sup> Deutsche med. Wochenschrift, December 29, 1898.

<sup>4</sup> Pacific Medical Journal, October, 1898.

<sup>5</sup> Gaz. des Hôpitaux, 1899, No. 4.

<sup>6</sup> Medical Record, September 4, 1898.

<sup>7</sup> Kansas City Lancet, October, 1898.

<sup>8</sup> New York Medical Journal, September 24, 1898.

a necessary means of diagnosis. The diminution of urea is such as occurs in other disturbances which lower nutrition, and the condition of the blood is usually that of a secondary anæmia. Even after having made out an induration in the region of the stomach in cachectic individuals, the utmost caution must be exercised before pronouncing the word cancer. Phlebitis, as a symptom, has occurred often enough to attract attention. Lancry<sup>1</sup> reports a case, and refers to communications on the subject by Kelch and Ballin,<sup>2</sup> and to one by Surmay,<sup>3</sup> and another by Jaccoud,<sup>4</sup> as a means of early diagnosis of gastric cancer. Albu<sup>5</sup> relies most on the gradual decrease of free hydrochloric acid in the stomach contents, the progressive diminution of the motility of the stomach, and the reappearance of lactic acid as the motility decreases. After the removal of stagnation by operation he found that lactic acid disappeared and hydrochloric acid may continue or reappear in the stomach contents. This behavior of hydrochloric acid must be very exceptional, although I have once observed it. The appearance of the Oppler-Boas bacillus in the gastric contents is almost invariable in this disease. Julius Ullman<sup>6</sup> relates his experience in Boas' clinic, his personal experience since, and his observation of the cases of Knickerbocker.<sup>7</sup> Both Ullman and Knickerbocker affirm that the bacillus is rarely absent in this disease, and that they have never found it present in any other. It may occur when free hydrochloric acid is present, but it is more likely to appear with failure of hydrochloric acid and the development of lactic acid. Organisms closely resembling the Oppler-Boas bacillus have been found in non-cancerous cases, such as that reported by Karl Sternberg.<sup>8</sup>

It cannot be said that the latter has altogether discredited the value of this bacillus as a means of diagnosis, but it is coming to be acknowledged, even by Boas, that the organism is not pathognostic.

Hensen<sup>9</sup> discovered infusoria buried in the mucus in a case of cancer of the stomach, particularly on the upper layer of the least ulcerating portions of the surface of the tumor.

The fact remains, that a positive early diagnosis of cancer of the stomach cannot be made by examination of the stomach contents. Nevertheless, by this means, when the examinations are repeated at intervals for a sufficiently long time, a very approximate diagnosis is to be anticipated. One expects to find the slowly decreasing secretion of

<sup>1</sup> Bulletin Médical, January 7, 1899.

<sup>2</sup> Bulletin Médical, 1895, No. 83.

<sup>3</sup> Arch. für Verdauung. Krank., 1898, Bd. lv.

<sup>4</sup> Buffalo Medical Journal, August, 1898.

<sup>5</sup> Philadelphia Medical Journal, September 18, 1898.

<sup>6</sup> Wien. med. Wochenschrift, 1898, No. 31; The American Journal of the Medical Sciences, December, 1898.

<sup>7</sup> Deutsche Archiv klin. Med., Band lix., Heft 3 and 4.

<sup>8</sup> Assoc. Med. des Hôpitaux, 1897.

<sup>9</sup> Ibid., 1895, No. 60.

hydrochloric acid, and after a time the appearance and gradual increase of lactic acid, the development of the well-known symptoms of food stagnation, and the presence of the Oppler-Boas bacillus. These, with cachexia, loss of weight in spite of treatment for chronic gastritis, and the depreciation in the blood, when such are not otherwise obviously explained, make the diagnosis of cancer highly probable. The blood should be examined, as in most cases it contributes something to the picture of carcinoma, although no result can be reached which establishes a differential diagnosis. There is, according to V. Jez,<sup>1</sup> first, anæmia, often of a severe type. Leucocytosis may arise, first, in hemorrhage; second, in secondary softening ulceration. F. P. Henry<sup>2</sup> reports that in the blood-counts of carcinoma he finds that the red cells sink to between 2,000,000 and 3,000,000 per cubic millimetre, but has never seen them below a minimum of 1,500,000. He makes the point that in malignant disease the cachexia is relatively more advanced than is the decline in the blood, whereas in pernicious anæmia the cachexia is less marked than one would expect with so high a degree of oligocythæmia. Jez holds that a digestive leucocytosis is usually, although not invariably, absent in this disease. It is interesting to compare the observations of Hofmann,<sup>3</sup> who in twenty-four cases of cancer of the stomach found digestive leucocytosis absent in all but three; in nine cases of *ulcus ventriculi* it was absent in all but two cases. It appears, therefore, to be absent about as often in one disease as in the other, and we must cease to regard it as of great diagnostic utility. G. Manchetti<sup>4</sup> regards leucocytosis as occurring in direct proportion to the proteolysis, and shows that it may occur in carcinoma when digestion continues.

The views of Dulin,<sup>5</sup> that death in carcinoma of the stomach is not in the majority of cases due to systemic infection but to obstruction by tumor or the destruction of gastric glands, received corroboration in the results following gastro-enterostomy. It is not uncommon to find patients rapidly improving in blood and gaining in flesh for several months after the relief of food stagnation. The views of Wrobleusky, that the urine contains a diminished amount of chlorine while the sodium chloride occurs in the feces in a normal degree, are not thoroughly established. In Schlatter's<sup>6</sup> case of total extirpation of the stomach, studies were made to ascertain what effects the operation had upon the process of assimilation. So far as could be ascertained there were none. The nitrogen output was found to be undisturbed by the removal of the stomach, and the excretion curve was quite the same as that under normal conditions.

<sup>1</sup> Wien. med. Wochenschrift, 1898, Nos. 14 and 15.

<sup>2</sup> Arch. für Verdauung. Krank., Band iv., Heft 1.

<sup>3</sup> Zeit. für klin. Med., Band xxxiii., p. 460.

<sup>4</sup> Lettimana Medica delo Sperimentale, November 12, 1898.

<sup>5</sup> Kansas City Lancet, October, 1898.

<sup>6</sup> London Lancet, November 19, 1898.

The present views as to our means of diagnosis of cancer of the stomach were well epitomized by Ewald before the British Medical Association at the Edinburgh meeting, July 26-28, 1898. He stated that the presence of lactic acid is as little specifically characteristic of cancer as is the absence of free hydrochloric acid. Lactic acid only occurs in gastric cancer after serious alterations of digestion have appeared, and usually after a palpable tumor is present. Quite as much as ever, therefore, the demonstration of tumor of the stomach, the size, position, and mobility, are the best criteria for operation. Ewald does not discredit the importance of the study of the gastric contents nor the appearance of cachexia. Unfortunately, these conclusions do not help in the early diagnosis. To this end many are working, but it is yet rather remote.

**Syphilis of the Stomach.** This condition sometimes resembles malignant disease, as in the case reported by E. Fraenkel.<sup>1</sup> A man, forty-seven years old, who during life suffered from subjective gastric symptoms and the absence of free hydrochloric acid, died from perforative peritonitis. In the stomach were found thirteen ulcers of various sizes. There were many in the intestine, of which eighteen had perforated. Histological examination revealed the case to be syphilis.

Fraenkel regards syphilis of the stomach as rare, although Dieulafoy<sup>2</sup> states that it is not so rare as it is supposed to be, and that the lesions occur in various forms: hemorrhagic erosions, gummatous infiltration of the submucosa, gummatous plaques, circumscribed gummata, gummatous ulcerations, and cicatrization. He believes that the corrosive action of gastric juice is exercised here as in simple ulcer, and that the symptoms of syphilitic ulceration may reproduce those commonly observed in simple ulcer. When these symptoms develop in the syphilitic he thinks it wise to regard them as specific in origin. He reports an interesting case, which after being repeatedly and unsuccessfully treated for gastric ulcer was ultimately cured by mercury and iodide. The gastralgia of syphilis may, therefore, more frequently depend upon a lesion than has been supposed. Cases of this affection are reported by Allen Jones,<sup>3</sup> who refers to a series reported by Kiser and to another by myself. In his cases other affections were excluded, and relief resulted from anti-syphilitic treatment, particularly the iodides.

**Tuberculosis of the Stomach.** Tubercular ulceration of the stomach may be mistaken for simple ulcer. Petruschky<sup>4</sup> reported two cases that responded to the tuberculin test. The rarity of tubercular disease of the stomach is rather extraordinary when we consider the sources of

<sup>1</sup> Deutsche med. Wochenschrift, 1898, No. 52.

<sup>2</sup> Bulletin Médical, 1898, No. 40.

<sup>3</sup> Philadelphia Medical Journal, April 29, 1899.

<sup>4</sup> Centralbl. für innere Med., 1899, No. 18.

infection, and, according to Senn,<sup>1</sup> is dependent upon the fact that the bacillus tuberculosis loses its virulence or dies in the presence of an acid medium. It is highly probable that tuberculosis is not rarely a factor in the production of various stomach affections.

Max Beck<sup>2</sup> reports the very interesting results that followed the injection of tuberculin in a large number of dispensary patients, and was surprised to find with what frequency they reacted even when there was no physical sign and when the ordinary symptoms of tuberculosis were absent. In his series occurred 47 cases diagnosed as gastritis, of which 28 reacted. In ulcer ventriculi 10 reacted, a proportion of 66 per cent. In 62 cases of gastro-enteritis, 29 reacted; in 13 cases of peritonitis, 7 cases reacted. This shows that tuberculosis may be the unseen agent, upon the activity of which certain digestive troubles remain intractable. In this connection attention should be directed to the various gastric disorders which are seen in incipient phthisis, a subject that has been studied by Wilhelm Croner.<sup>3</sup> After examining many cases he found that it was impossible to distinguish between the conditions found in the tubercular from those in the non-tubercular. Eructations and sensations of distention, succussion over the epigastrium, and irregularity at stool are common symptoms. There was no anatomical dilatation, and enteroptosis occurred only in a minor degree. He found no regularity in the gastric chemistry; motility was not much disturbed, but a light acidity was the rule.

In personal experience these views are justified. I have occasionally seen very marked dilatation and gastropptosis, neither of which events should excite surprise when we consider the large number of cases of tuberculosis. The tubercular state contributes to the development of digestive diseases much in the same manner as do other conditions that are accompanied by depression and toxæmia.

**Shape and Position of the Stomach.** In a contribution coming from H. W. Bettman,<sup>4</sup> of Cincinnati, it is shown that there are several distinct types, both as to shape and position, of the stomach. Ordinarily the long diameter is slightly more than twice the vertical. The relationship between the vertical and the long diameters is very variable. In the senile stomach Bettman finds no definite change in the shape, but in the foetal stomach he finds striking differences in form. Contrary to other observers, he holds that the fundus occupies relatively the same space in the foetal as in the adult stomach, which is about 28 per cent. of the total length. The interesting observation is made that the cardiac orifice is very much nearer the anterior than the posterior wall of the

<sup>1</sup> Journal of American Medical Association, June 4, 1898.

<sup>2</sup> Deutsche med. Wochenschrift, March 2, 1899.

<sup>3</sup> Ibid., 1898, No. 48.

<sup>4</sup> Philadelphia Monthly Medical Journal, March, 1899.

organ, so that about two-thirds of the fundus lies behind the outlet of the œsophagus. Bettman believes that confusion regarding the shape of the stomach depends upon the fact that the organ is examined during different degrees of distention. The contracted stomach lies with its axis

FIG. 1.



Stomach of an adult male seen from above and showing the asymmetrical insertion of the œsophagus.

downward and to the right. It becomes horizontal when the stomach is moderately full. The most fixed portions are the cardia and the pylorus; the latter should not be more movable than 3 cm. in any direction. Bettman also makes the interesting and original observation that the œsophagus "does not enter the stomach at a point equidistant from the anterior and posterior surfaces of the stomach. The cardiac

orifice is invariably much nearer the anterior than the posterior wall." Bettman states that this asymmetry of insertion is constantly present, occurring in all the stomachs examined, both foetal and adult. In general, it may be stated that about two-thirds of the fundus lies behind the cardiac orifice. (See Fig. 1.)

M. Pflaunder<sup>1</sup> disputes the statement that the capacity of the stomach in different individuals shows enormous variations, and believes that these conclusions were reached without due regard to the questions of internal pressure and power of contraction, and without relation to the length of the individual. He finds that a nursing child has a smaller stomach than one artificially fed, and that the capacity of the normal stomach is relatively smaller than that of the diseased. The capacity bears a relation to the size of the pyloric opening. When the latter is narrow there is a greater stomach capacity, and when wide the stomach is relatively small. Objection has been raised to the umbilicus as the landmark in describing the location of the stomach. For this reason Rosenfeld<sup>2</sup> suggests the drawing of a series of lines as a guide. One of these crosses the abdomen, connecting the tips of the tenth ribs, the second connecting the highest points of the iliac crests, and the third the anterior superior spines of the ilium. Rosenfeld found that two-thirds of the lesser curvature of the stomach occupies a vertical position, or even slanted slightly to the left. The remaining portion is directed horizontally to the right or slightly upward, thus making the stomach vertical as regards the cardiac portion and horizontal in the pyloric portion; when the stomach is moderately full it rotates more to the front. Rosenfeld regards gastroptosis as evidence of the presence of dilatation. Such enlargement may take place either in the vertical or horizontal direction, or there may be a third form, with dilatation in both directions. He has reached his conclusions by means of the X-ray, the shadow being produced by a sound filled with shot introduced into the stomach to various distances.

Bianchi and Comte<sup>3</sup> have made some interesting experiments in regard to the shape and position of the stomach by means of the phonendoscope, and their conclusions for the most part substantiate the statements of Bettman and Rosenfeld. They believe that the lower border of the stomach is lower down in direct proportion to the weight of the food taken as well as to the resistance of the walls and the supports of the stomach. In health the cardia sinks and the pylorus is pushed toward the median line during distention; the upper curvature may rise if the stomach contains much gas. The stomach, therefore, changes its position

<sup>1</sup> Wien. klin. Wochenschrift, 1898, No. 44.

<sup>2</sup> Centralbl. für innere Med., January 7, 1899.

<sup>3</sup> Arch. de Physiologie, 1891, No. 4.

very considerably, according to its functional activity and the nature of its contents.

**GASTRIC DISLOCATION.** Bettman, in the article before quoted, states that lateral displacements are of little consequence. Upward displacement may occur in diaphragmatic hernia. He refers to the great frequency of gastropotosis, and considers all cases in which the lesser curvature can be demonstrated below the free border of the liver to be instances of gastropotosis. Stretching of the gastrosplenic and hepatic ligaments leads to the descent of the pyloric part and the lesser curvature of the organ. Therefore, in gastropotosis the stomach occupies a relatively vertical position. While this is generally true, it certainly is not universal, for I occasionally find gastropotosis in the horizontal stomach. In a total number of seventy-two cases reported by Bettman, 85 per cent. were in females, and occurred irrespective of child-bearing. Meinert believes that 50 per cent. of girls at the age of twelve years have dislocated stomachs, while Kuttner and Dyer are quoted as saying that in 100 children they found no gastropotosis; in 100 men, 4, and in 100 women, 42. Bettman believes that this condition exists in from 50 to 95 per cent. of all women. It is certainly very common.

*The causes of gastropotosis* are divided into three classes: (1) Conditions that tend to push the stomach downward from above; (2) those that lead to the diminution of intra-abdominal pressure and relaxation of the supporting ligaments; (3) those which lessen the support beneath the stomach and drag it downward. Etiologically, there exists hereditary predisposition and constitutional disability plays an important part. The most common of causes is to be found in improper dress, as seen in corsets and especially the bands of skirts. To this another important cause should be added, and that is neglect in the development of the abdominal muscles and in improper posture in standing. Emaciation, pregnancy, enlargement of the liver, and overdistention of the abdominal viscera, beside emphysema and other thoracic conditions that lower the diaphragm, all play a small part in the cause of this displacement.

Paul Delbet<sup>1</sup> reports an instance of gastropotosis in which the stomach was adherent to the brim of the pelvis. Together with the adherent omentum, it could be felt as a tumor-like mass in this position. Traction from adhesions exercises marked influence on the position as well as the function of the stomach. In rare instances a gastrocholic symphysis occurs—in other words an intercommunication—as reported by L. Bouveret.<sup>2</sup> Beck had collected from literature sixty cases of this condition. The two most striking signs are intense and rapidly developing anæmia and profuse lenteric diarrhœa. Vomiting is very infrequent, but sali-

<sup>1</sup> Arch. Generale de Medecine, 1899.

<sup>2</sup> Revue de Medecine, April 10, 1899.



vation, nausea, and violent retching may occur, in which effort the contents of the stomach are propelled into the colon.

**DIAGNOSIS.** For the recognition of gastropotosis, Thue<sup>1</sup> recommends the employment of the gastrodiaaphane.

Attention has been directed by Karl Stern<sup>2</sup> to the possibility of recognizing the position of the stomach by means of the slight shadow seen upon the abdominal wall during the respiratory movement when the stomach is somewhat distended. The patient should be placed upon his back, with the light entering nearly on a level with the body from the direction of the head. In instances of marked gastropotosis, Stern was able to make out the smaller curvature as well as the other contours of the stomach. The method possesses some value, but is useless where the abdominal wall is thick and tense. It is necessary to have the stomach partially distended with fluid beside some gas. The coils of intestine, when distended, may be recognized in the same way. There are few conditions more easily recognized than gastropotosis, in most cases, to one who is skilled in abdominal examinations. The gastrodiaaphane and the X-ray method, using either a bismuth mixture or the shot-filled stomach-tube, enable us to make the diagnosis more definite, and they are important in exceptional cases that may not be recognized by ordinary methods. Inspection of the abdomen after the stomach has been distended with air by means of the stomach-tube and bulb is all that is necessary for a diagnosis in a great majority of cases.

**HOURLY CONTRACTION OF THE STOMACH** appears in certain cases to be an anatomical change in some way related to the physiological constriction that occurs near the middle of the stomach, and which almost completely separates the pyloric from the cardiac end during gastric peristalsis. This is referred to by Bettman in the article before quoted, but reference is also made to instances of the congenital type and to constriction secondary to cicatrization, to cancer of the stomach, and to a variety of other conditions, such as torsion, peritoneal bands, extragastric tumors, or hernia through the mesocolon, as causes of the deformity. The chemistry in the two compartments of these stomachs is occasionally strikingly alike. The coarser particles of food are held in the fundus, and for the most part only the fluids pass through the constriction into the cardiac portion.

**Dilatation of the Stomach.** The X-ray method, after introducing a sound filled with shot, to which reference has been made in the preceding section, is regarded by G. Rosenfeld<sup>3</sup> as the only reliable means of diagnosis of gastroectasis. The author does not make it clear how he

<sup>1</sup> Norsk. Mag. f. Lægevidensk, December, 1898.

<sup>2</sup> Centralbl. für innere Med., October 29, 1889.

<sup>3</sup> British Medical Journal, September 17, 1898.

would differentiate between ptosis and dilatation. By merely finding the lower border of the stomach one is not enabled to state the size of the organ. The shot method previously referred to is of some value in the recognition of gastropptosis, is also of value in gastroectasis, and is recommended by Stern.<sup>1</sup>

Armstrong,<sup>2</sup> before the Harveian Society of London, divided the disease into acute and chronic dilatation, the former occurring in the course of typhoid, rheumatism, and other diseases, and Armstrong regards it as the cause of the otherwise unexplained tardy convalescence in some instances. The chronic dilatation he divides into obstructive and idiopathic. These views are not new and are those accepted by most internists. Michaelis<sup>3</sup> advances an interesting idea in likening the antrum pylori to the ventricles of the heart and the fundus to the auricles. He believes that dilatation occurs first in the antrum pylori and that the dilatation of the fundus follows this. The recognition of the preliminary dilatation of the antrum, he thinks, may be possible by noting the increased distance from the median line assumed by the right border of the stomach when the organ is distended with gas. He reckons that the normal distance of the right border is 7.75 cm. to the right of the median line, and the dilated antrum he finds at a distance of from 9 to 12 cm. The theory that the dilatation begins in the antrum is interesting, but the method of recognition is faulty since the position of the stomach is by no means sufficiently fixed to render his rule free from error. Beside, it should not be forgotten that the most harmful factor in gastroectasis is not so much the size of the organ as it is the food stagnation that accompanies it. On this point Max Einhorn<sup>4</sup> gives evidence in emphasis of what he had previously written. He recalls the fact that the important condition of the disease is the imperfect propulsion of stomach contents into the intestine, a phenomenon that may occur without material increase in the size of the stomach; and, on the other hand, the stomach may be quite large without the appearance of food stagnation. For this lagging of the gastric contents he again proposed the name "ischochymia." The question is a little difficult, and perhaps for the present cannot be settled. Sometimes in acute dilatation there is the absence of food stagnation, and yet the functions of the stomach are, as a rule, seriously disturbed. It would seem that in the classification the term "dilatation" must be retained, yet for the most part the symptoms that arise distinctly relate to the stagnating contents. The diagnosis of this condition may easily be made by repeatedly finding

<sup>1</sup> Centralbl. für innere Med., October 29, 1898.

<sup>2</sup> British Medical Journal, April 9, 1898.

<sup>3</sup> Cited, Centralbl. für innere Med., 1899, No. 9.

<sup>4</sup> Zeit. für klin. Med., Band xxxv., Heft 5 and 6.

in the stomach before breakfast remnants of food taken the evening before—taken in connection, first, with the usually present increased size of the stomach; second, the thickened and perhaps palpable pylorus; and, third, the persistent gastric unrest. I regard the last as a most important symptom, and one that may often be recognized easily by inspection of the abdomen while the patient lies upon his back. The slowly moving peristaltic waves are much more often visible in this condition than is generally supposed. Such symptoms usually mean obstruction at the pylorus. Whether it will turn out to be malignant or benign is not always easily determined.

As the result of serious muscular atony it is possible to have food stagnation, but in such a case gastric unrest is not seen. The discovery of bile in the gastric contents does not necessarily mean atony; for, as Einhorn has shown, the pylorus may be partially obstructed by the growth of fibrous tissue in such a way that the narrowed orifice remains constantly open.

The interesting subject of GASTRIC TETANY AND ITS RELATION TO DILATATION OF THE STOMACH has been enriched by numerous contributions. Among others, by Mayo Robson,<sup>1</sup> by Sievers,<sup>2</sup> by Juergensen,<sup>3</sup> by J. S. McKendrick,<sup>4</sup> and by Kuckein.<sup>5</sup> The last named described one of the few reported cases of tetany associated with gastric dilatation dependent upon malignant disease. This is of special interest because it disproves the theory of Bouveret and Devic, that free hydrochloric acid and alcohol must be present in the gastric contents to produce tetany. A similar case has been reported by Siebert. Kuckein believes that the thickening of the blood resulting from the non-absorption of fluid accounts for the tetany. This theory was advanced by Kussmaul, and Juergensen thinks that it played some part in the production of the tetany in his case because there was a gradual diminution in the quantity of urine secreted; but he also believes that that overworked agent, auto-intoxication, was involved, which is altogether probable, since his patient most certainly had uræmia. At present auto-intoxication is the most commonly accepted cause of this affection. Sievers repeats the suggestion of Frankl Hochwart, who holds that tetany may be an infective disease. He also regards the contention of Bouveret and Devic as unsatisfactory, as he found that three out of twenty-seven cases that he had collected were complicated with carcinoma. It is only fair to the French observer to

<sup>1</sup> Leeds and West Riding Medico-Chir. Society, November 14, 1898; *British Medical Journal*.

<sup>2</sup> *Berliner klin. Wochenschrift*, August 1, 1898.

<sup>3</sup> *Arch. für klin. Med.*, vol. lx.

<sup>4</sup> *London Lancet*, September 24, 1898.

<sup>5</sup> *Philadelphia Medical Journal*, December 17, 1898; *Berliner klin. Wochenschrift*, November 7, 1898.

remember that it is possible to have free hydrochloric acid and alcohol present in the carcinomatous stomach. The great majority of instances of tetany occur in cases of dilatation following cicatrized peptic ulcer at the pylorus. Mayo Robson<sup>1</sup> regards tetany as the result of reflex irritation produced by painful contraction of the pylorus, supplemented by the absorption of toxic matter from the stomach. The question must be left to further investigation. Robson reports having operated upon three cases of gastrectasia attended with tetanic symptoms, all of which were relieved. It was at one time believed that gastric lavage was responsible for the attacks—a view now generally discarded.

**TREATMENT.** Trevelyan<sup>2</sup> recommends the thorough washing of the stomach, stimulation, and the supply of liquid to the body by means of saline injections.

In fermentation with food stagnation, Bandoin<sup>3</sup> recommends fluoride of ammonium. It is non-toxic, has no unfavorable effect on the chemical ferments of the stomach, is well tolerated, and destroys lactic, butyric, and acetic acid fermentations. From personal experience I believe this to be a drug of considerable importance. For the same condition Einhorn recommends resorcin in 3 to 5 grain doses, with 20 grains of subnitrate of bismuth in a watery mixture.

As for the general treatment of dilatation, lavage, electricity, and a soluble and concentrated diet remain our chief reliance. Boardman Reed<sup>4</sup> recommends a strong faradic current. Armstrong, before quoted, deprecates the use of electricity by internal methods. In discussing his paper, Herschell advises the intragastric spray, and Manders exhibited and recommended for its convenience in treatment a combined gastric electrode and stomach-tube, prepared from silk interwoven with fine wire, an old idea better effected by an American contrivance reported more than ten years ago. Dr. Hewitt recommends recumbency as a means of preventing the dragging downward of the stomach, and suggests the elevation of the foot of the bed as aiding in the relief of this condition.

**Pyloric Stenosis.** In an admirable article by Boas<sup>5</sup> the question of inflammatory hypertrophy of the pylorus is described under the name of stenosing gastritis. He distinguishes between this and benign hypertrophy of the pylorus from various other causes, a differentiation that hitherto has not been sufficiently conspicuous. Benign stenosis, described by old writers from Cruveilhier down, lacks something in the completeness of the details supplied. Cirrhotic gastritis, first described by Hanot, is usually accompanied by similar changes in the liver, pancreas, and

<sup>1</sup> London Lancet, November 28, 1898.

<sup>2</sup> Leeds and West Riding Medico-Chir. Society, November 14, 1898.

<sup>3</sup> Gaz. heb. de Med. et de Chirurgie, October 2, 1898.

<sup>4</sup> International Medical Magazine, June, 1899.

<sup>5</sup> Arch. für Verdauung Krank., Band iv., Heft 1.

other organs. So-called cirrhosis of the stomach with hypertrophy of its mucous membrane, so well described by Nothnagel, is a different affection, with obscure symptomatology. Congenital stenosis must also be excluded. Boas reports three recent cases, and as his conclusions have been verified in my personal experience, I believe them to be sound. The course of the disease is chronic. The early symptoms include a sensation of distention, with eructations and occasionally pyrosis; in the second stage there occur pain and vomiting, to be followed by the ordinary symptoms of food stagnation, although the stomach generally does not reach great dilatation; the appetite remains good. Peristaltic unrest is a striking feature, and the movements are usually visible through the abdominal wall. The pylorus becomes palpable and hard; on an ordinary diet solid particles are found in the residuum, even after a somewhat prolonged fast; with liquids the stomach usually empties itself, but not without increased suffering. In one of Boas' cases even liquids were not retained. Free hydrochloric acid was absent in all of his cases and in my own. Boas found the ferments decreased in two, lactic acid fermentation present in all, and when the residuum was not large, the Boas-Oppler bacillus was found, but not *sarcinæ*. These facts imply a deep-seated change in the gastric mucosa, and strongly suggest malignancy; but the rise and decline of symptoms, including the weight and the improvement to be observed on a selected liquid diet, lavage, and soothing measures, point to the benign character of the affection. It differs from cicatricial pyloric stenosis in the absence of a history of gastrorrhagia and in the diminution of free hydrochloric acid. It differs from the primary atonic dilatation, because of the increase in peristalsis and because of the presence of gastritis. The great difficulty lies in the differentiation between this and gastric carcinoma; the criteria are the age, history, and the course of the disease, including absence of progressive changes in motility. As before intimated, the condition is improved by a bland, liquid diet, by lavage, and by soothing applications. Boas believes that the only means of obtaining a permanent cure is by operation.

Hayem<sup>1</sup> states that marked ectasia is not necessarily resultant of stenosis, and affirms that large dilatation may be seen in other conditions. While in pyloric and subpyloric stenosis large dilatation is the rule, it may, on the other hand, be less voluminous than normal, even when insufflated. The causes for this lessened gastric capacity are variable: An intolerance to food, followed by incessant vomiting; the existence of peritoneal bands preventing distention; restriction of alimentation, because of the pain provoked by digestion, are all causes. Nor is the dilata-

<sup>1</sup> Bulletin Médical, 1898, No. 92.

tion in proportion to the degree of stenosis ; both conditions may be met with in acute as well as in chronic obstruction, by ulcer and by cancer.

Hayem reports three cases, one resembling cancer of the pylorus and the other showing evidence of restriction by means of adhesions following perigastritis. Perigastritis is most frequent in ulcer. This shows that dilatation is not an infallible rule in the diagnosis of stenosis. He states that there exists but one infallible symptom of stenosis, and that is, that while fasting there will be found liquid residue containing alimentary débris, and that whether the stomach be large or small. In other words, food stagnation, not the presence of gastrectasia, is the guide.

A cause of pyloric obstruction is reported by Maugourd,<sup>1</sup> who has collected a number of these cases, in the escape of biliary calculi from the gall-bladder into the stomach through a process of ulceration. Relief must generally be obtained by laparotomy. Numerous instances, with reports of studies on congenital hypertrophic stenosis of the pylorus, have appeared. Carl Stern<sup>2</sup> reports a case with autopsy. In this, and according to Pflaunders<sup>3</sup> in the majority of other reported cases, there was no true stenosis, but the stomach was found contracted in spasm, apparently the result of functional excitement. While this is the prevailing opinion, Van Hammer<sup>4</sup> reports the case of a girl, three days old, operated upon for atresia ani ; death having resulted, there was found at autopsy a complete atresia of the pylorus also. The importance of the affection is dwelt upon by Edward Cautley.<sup>5</sup> In one case the pylorus was found, post-mortem, represented by a well-defined cylindrical and thick-walled tube, with an exceedingly small lumen and complete occlusion at one point. The characteristic symptoms of the disease are : First, vomiting, without apparent cause and not relieved by treatment ; second, absence of bile from the vomit ; third, obstinate constipation ; fourth, marasmus ; fifth, the presence of a tumor in the region of the pylorus ; sixth, the absence of abdominal distention, except that related to the stomach ; seventh, absence of symptoms of gastritis and intestinal obstruction. Cautley recommends surgical intervention. Before the same society, Still<sup>6</sup> reported three cases and reviewed the theories of its pathology, as follows : First, that it is spasmodic and arises after birth as the result of local irritation. This he discards, because the hypertrophy is too great to develop in a short time. Second, that it is a primary congenital stenosis. This is disproved, in the fact that measurements show that the orifice in some cases is not diminished. Third, that it is a developmental

<sup>1</sup> Bulletin Médical, 1898, No. 101.

<sup>2</sup> Deutsche med. Wochenschrift, No. 38 ; Klin. med. Wochenschrift, October 20, 1898.

<sup>3</sup> Wien. klin. Wochenschrift, 1898, No. 45.

<sup>4</sup> Prag. med. Wochenschrift, 1899, No. 3.

<sup>5</sup> British Medical Journal, November 12, 1898.

<sup>6</sup> Ibid., February 11, 1899.

hyperplasia of the pyloric muscles. This is negatived by the recovery that ensues in a few cases. The fourth theory, with which the speaker is in accord, viewed the hypertrophy as due to spasm, depending on a disturbance of nervous co-ordination. This accords with the views of Pflaunder.

The facts at hand show that in some cases there is absolute occlusion of the pylorus, and in others that there is apparently a functional spasmodic closure that does not depend upon local irritation, and must be explained through the disturbance of the nervous mechanism.

**TREATMENT.** Pflaunder recommends local anodyne applications, warm compresses, baths, and systematic lavage. When this treatment does not procure relief the indications for laparotomy are apparent.

There is, perhaps, too great a tendency to operate in benign pyloric stenosis. Hayem<sup>1</sup> sounds the alarm over this indiscriminate practice, and points out that the operation is a grave one, and should be employed only where the stenosis is very advanced and not where it is slight. He says that when he hears a surgeon announce that in sixty-one operations for gastro-enterostomy it was forty-six times for the relief of extrinsic or intrinsic stenosis, he cannot help saying that the fact is to be regretted. He refers to the disappearance of free hydrochloric acid from the stomach contents after the use of a free opening into the intestine, and holds that if there is a moderate valve-like obstruction, hydrochloric acid remains. He has seen trouble from the reflux of bile into the stomach.

Mathieu's<sup>2</sup> studies of digestion after gastro-enterostomy lead him to conclude that the back flow of bile is not a contraindication to the operation. Lissal and Beylac<sup>3</sup> concluded that the type of digestion completely changes after gastro-enterostomy for benign stenosis. The hyperchlorhydria changes to a condition of achlorhydria and hypopepsia; digestion continues, although weakened, and motion seems to be accelerated. We may be sure that gastric digestion is not restored after gastro-enterostomy, but after pyloroplasty, on the contrary, it often is. Also, that the regurgitation of bile after gastro-enterostomy occasionally gives rise to gastric distress. Practically, in all cases after this operation achlorhydria supervenes.

**Gastric Neurosis.** J. Morton Prince<sup>4</sup> calls attention to what he terms psychoneurosis as a true functional disease. It is his idea that an organ forms the habit of responding to the customary stimuli of what may be regarded as pathological reactions. In other words, a functional disease is the result of a voluntary or involuntary education, caused by the constant repetition of the phenomena that may have their origin in organic

<sup>1</sup> Bulletin Médical, 1898, No. 28.

<sup>2</sup> La Semaine Médicale, October 22, 1897.

<sup>3</sup> Bulletin Médical, 1898, No. 4.

<sup>4</sup> Boston Medical and Surgical Journal, December 15, 1899.

disease, pernicious habits, strong emotions, wear and tear of life, as well as the effects of toxic substances. His paper is interesting and suggestive. A simpler view is advanced by De Langenhagen<sup>1</sup> (of Plombières), who holds that reflex action plays a more considerable part in the affections of the digestive tube than is ordinarily believed. To gastric irritation he would ascribe the sympathetic phenomena, such as palpitation, arrhythmia, flushing, œsophageal spasm, diplopia, vertigo, aphasia, syncope, etc., while the graver disturbances and those producing modification of nutrition, such as neurasthenia and hypochondria, he would attribute to auto-intoxication. He believes that the chronic affections of the digestive tube are almost always found in nervous subjects, but when once established they react in their turn on the nervous system. Attacks closely simulating migraine are believed by Dol<sup>2</sup> to be the result of muscular gastric atony. The author evidently fails to take into consideration the causes that produce brain-irritation, aside from the disturbances in the primary digestion. It is always difficult to exclude gastro-intestinal or hepatic toxæmia in cases of central or reflex nervous irritation.

Legendre<sup>3</sup> makes the important observation that dyspepsia is far more frequent among students now than in the time of our fathers, and yet hygiene, in the popular acceptance of the term, is to-day far better. He attributes this partly to heredity, partly to acquired dyspepsia and neurasthenia. He recommends a simpler dietary, and warns against the abuse of physical sport, while advising the careful examination of school children by a physician at regular intervals. Singularly enough, the question of eye-strain seems not to have attracted the writer's attention.

Seymour Boesch<sup>4</sup> makes a very careful study of gastric crises, beginning with Charcot's article, published in 1868. The following features of the attack he regards as characteristic of the gastric crises: First, absence of all symptoms of organic disease of the gastro-intestinal tract; second, the suddenness of the attack; third, absence of the initial chill; fourth, great intensity of the symptoms, which increase in severity; fifth, slow pulse and absence of fever. To these are added the absence of characteristic conditions of the vomited matter, the spontaneous diminution of the attack, and the rapid convalescence.

**Motor Neurosis.** It is well known that hysterical patients practice the taking of air into the œsophagus and stomach, bringing it up with noisy eructations. This condition is described by E. L. Tompkins,<sup>5</sup> who regards it as a somewhat rare affection. He quotes Wyllie, of Edin-

<sup>1</sup> Bulletin Médical, 1898, No. 35.

<sup>2</sup> Gaz. heb. de Med. et de Chir., June 5, 1898.

<sup>3</sup> Progrès Medical, October 27, 1898.

<sup>4</sup> Arch. für Verdauung Krank., Band v., Erstes Heft.

<sup>5</sup> American Journal of Obstetrics, September, 1898.



burgh, who recommends the introduction of a good-sized cork between the molar teeth, to prevent the patient from swallowing air.

**TREATMENT.** Tompkins' case was only relieved by treatment for hysteria, and he recommends hyoscyamus, camphor, and valerian. Joseph Taber Johnson reported a case apparently dependent upon floating kidney and relieved by nephrorrhaphy. A. F. A. King spoke highly of valerian in contradistinction to the valerianates, and referred to the occasional occurrence of alarming intestinal distention in hysteria that disappeared quickly by absorption and not by the discharge of gas. J. B. Harrison believes that musk is more valuable than valerian in these cases. H. L. E. Johnson reported a case in which no relief was obtained by valerian, but instant benefit followed the administration of iodoform. After failure with various drugs, Dr. Bromwell saw relief follow the administration of spirits of lavender, ammonia, and ether.

It will be seen that this well-known affection is not uniformly relieved by any one procedure. Experience shows that what is efficacious in one case may be absolutely useless in another. Lavage often affords relief, but the value of the tube probably depends upon the mental effect attending its use. Certainly suggestion is of marked service, and on the whole the condition should be treated as one of hysteria.

**Motor Insufficiency.** The treatment of motor insufficiency of the stomach is well reviewed by G. Küss,<sup>1</sup> who emphasizes the importance of separating the causes of real food stagnation, obstructive or otherwise, from those in which the aliment remains too long, but eventually reaches the intestine without alimentary residue in the stomach. This latter condition may arise from varied causes: First, temporary stasis from reflex contracture of the pylorus; second, motor insufficiency from weakness of the muscles of the gastric walls or from disturbed innervation. In some cases there occurs a complication of causes which succeed each other in the following order: Motor insufficiency of the stomach, alimentary stasis, abnormal fermentation, organic hyperacidity and pyloric spasm. In other words, the contracture of the pylorus may sometimes follow rather than precede atony of the gastric walls. Motor insufficiency is frequently a factor in dyspeptic conditions.

**TREATMENT.** The general remedies, according to Küss, are strychnine, ipecac, sodium bicarbonate, and orexin. Boas prefers the extract of *nux vomica*. Personally, I prefer the powdered or rasped *nux vomica*. When hyperacidity is associated with motor insufficiency, Boas combines *nux vomica* with magnesium, bismuth, and sodium bicarbonate. Mathieu recommends the last-named drug with ipecac; and also ipecac, colombo, and gentian. Penzoldt recommends hydrochlorate

<sup>1</sup> Bulletin Médical, 1898, No. 92.

of orexin in doses of 20 cm., while Klemperer and Pick report good effects from creosote. While these remedies are of some value, they should be considered as representing only one side of the treatment. Diet, electricity, and massage, together with hydrotherapy and all measures that improve the general health, are not to be neglected.

**Gastric Secretion.** The problems connected with gastric secretion increase in difficulty the more they are studied. A. Scheule<sup>1</sup> finds that the amount of food ingested has no proportionate effect on the secretion of pepsin or hydrochloric acid. The activity of both pepsin and hydrochloric acid increases with the progress of digestion. He finds the peptonizing power present in advanced cases of alcoholic and other forms of catarrhal gastritis. After elaborate experiments, Crone<sup>2</sup> concludes that hydrochloric acid, in the proportion of 0.05 to 0.1 per cent., shows the best digestion. The behavior of the gastric glands during starvation has been studied by Pawlow.<sup>3</sup> The act of mastication by a fasting dog led to the secretion of gastric juice, but this result diminished gradually, disappeared, and on the fifth day failed to appear. The proportion of acid to ferment continued the same so long as gastric juice was secreted. He concludes, in view of these facts, that during starvation the stomach is nourished at the expense of other organs, and its secretion merely awaits the ingestion of food, and that, for a time, the mere act of mastication is sufficient to excite it.

The old and new theories of secretion of the stomach are reviewed by A. M. Wirszubski,<sup>4</sup> who quotes Juergensen and Scheule, who, while admitting the practical use of milk in hyperacidity, are unable to explain it on theoretical grounds. Wirszubski believes that bitters stimulate the secretion of gastric juice, not directly, but by reflex irritation, and that psychical action excites appetite. This view is opposed by Becker, who holds that secretion is the result of direct irritation of the gastric cells. This is not in accord with the experiments of Pawlow, above noted, nor does it agree with clinical experience.

The behavior of the secretory cells is of importance, in showing the source of the functional disturbances. Inactivity in secretion may depend upon enteric disease. Thus hyperchlorhydria is usually accompanied by constipation and anacidity by looseness of the bowels; the latter fact is often overlooked by physicians, who direct their treatment toward the intestine when the real fault rests in the stomach—a matter to which Oppler and Wegele have especially called attention. M. and N. Labbe have shown that in children suffering from looseness of the bowels there is usually a change in the gastric digestion. Wirszubski

<sup>1</sup> Zeit. für klin. Med., 1898, Band xxxiii.

<sup>2</sup> Virchow's Archiv, Band cl., Heft 2.

<sup>3</sup> Botkin's Krankenhaus Zeitung, 1898, No. 41.

<sup>4</sup> Meditsina (St. Petersburg), RX., Nos. 25 and 26.

confesses to some confusion as to the rôle of pepsin and hydrochloric acid. He believes, with Konowaloff, that 0.2 per cent. is the standard of acidity that produces the best digestion, and not 0.5 of 1 per cent., which he claims is usually present. There must be some error in these figures, as 0.5 of 1 per cent. is an unusually high proportion of free hydrochloric acid to find present; the author must refer to the total chlorides. He believes that the indiscriminate use of hydrochloric acid is harmful, and quotes others in support of his views. The interesting fact is repeated that gastric juice is bactericidal, while neither pepsin nor hydrochloric acid exercise much effect in that way. Wirszubski believes that the entire physiology of the stomach must be studied anew, and that eventually this study will explain the etiology and pathology of many gastric disorders that are now obscure. There is, probably, much yet to be learned about the subject, and for the present, while cases are receiving the most careful study, a greater modesty is becoming.

**HYPERCHLORHYDRIA.** Two old ideas are revived by Soulier,<sup>1</sup> who believes, first, that sodium bicarbonate in small doses before meals stimulates the secretion of hydrochloric acid, as held by Claude Bernard, and he cites the views of Tournier, that the flow of hydrochloric acid into the duodenum acts as an excitant to the pancreatic secretion. The second revival is found in his belief that nitrohydrochloric and nitrosulphuric acids are better gastric stimulants than hydrochloric acid, the continued use of which, he thinks, leads to torpidity of secretion. Practically, these views are not of much importance.

Mathieu expresses a belief which meets with my sympathy, that lactic acid, if given immediately after meals before the hydrochloric acid appears, lessens the secretion of the latter, provided the motility of the stomach remains normal. I have many times seen the symptoms of hyperchlorhydria relieved by the taking of milk or buttermilk; but at such times it is important to make the patient avoid meats and other substances that excite hydrochloric acid secretion. Mathieu's views call attention to the fact that one cannot judge of the state of the gastric chemistry from the sensations experienced by the patient. It is well known that large doses of bismuth (12 to 15 grammes at a time) are of great use in the relief of symptoms of hyperchlorhydria, with or without ulcer. This view meets with the approval of Olivetti,<sup>2</sup> who agrees with Fleiner, that although the sensations of burning, pain and vomiting are controlled, the actual secretion of hydrochloric acid is not diminished. From a clinical study, S. Talma<sup>3</sup> arrives at the idea that the decomposition of carbohydrates leads to morbid processes in the gastric mucosa;

<sup>1</sup> Lyon Medical, July 24, 1898, No. 30.

<sup>2</sup> Bulletin Médical, 1898, No. 65.

<sup>3</sup> Zeit. für klin. Med., Band xxxv., p. 542.

it is his view that the products of fermentation cause moderate insufficiency, hyperchlorhydria as well as spasm of the pylorus, and that the juncture of these events leads to ulceration. These conclusions are too general and can only apply to some cases.

**GASTROSUCCORRHŒA.** The question of the gastric crises of locomotor ataxia is discussed by Douglas,<sup>1</sup> who found that in one case there was secreted a large quantity of digestive fluid slightly inferior to that produced in health. There was no hyperchlorhydria. In other words, there was present a temporary gastrosuccorrhœa dependent upon the central nervous influence. Banti<sup>2</sup> has expressed the idea that gastrosuccorrhœa is the result of hypertrophy and hyperplasia of the connective tissue of the gastric mucosa and spasm of the pylorus. According to Mathieu and Laboulais,<sup>3</sup> the syndrome of Reichmann is characterized by hyperchlorhydria through retention and the continued secretion of gastric juice that remains somewhat acid, even while fasting. In the grave forms there is more stagnation and large quantities of alimentary detritus are present. This form is sometimes accompanied by a moderate pyloric obstruction, on which point the authors agree with Hayem and Banti. Hayem believes that even the mild form may be attributable to slight pyloric stenosis, but the burden of proof rests with him on this point. The finding of gastric secretion, when fasting in the morning, shows that the element of secretion overbalances that of motion; but that is as far as one may go. When there occurs a retention of food the hypersecretion is still further exaggerated. Edsall,<sup>4</sup> in a critical summary of recent literature on the subject, recalls Schreiber's contention that continuous secretion is normal in the fasting stomach, in which view he is supported by Robin and Martins. Against this stand are the opinions of Hoffman, Pick, and Riegel, who support Reichmann's original report. Riegel regards the hypersecretion as an aggravation of hyperchlorhydria. Edsall remarks that there has been much earnest contention that gastrosuccorrhœa is not a disease *sui generis*, which he regards as unnecessary, since no one of authority has ever yet claimed that it was. This conclusion of Edsall is open to criticism, because there is no doubt that gastrosuccorrhœa is a different manifestation than hyperchlorhydria, and although it may be improper to class either as a distinct disease, it occupies a special niche as a functional disturbance.

**TREATMENT.** Hartman<sup>5</sup> reports a case of gastrosuccorrhœa associated with ulcer in which, after gastro-enterostomy, the pain disappeared but gastrosuccorrhœa persisted. At the same meeting Tuffier reported a case,

<sup>1</sup> London Lancet, April 15, 1899.

<sup>2</sup> Sperimentale, February 11, 1898.

<sup>3</sup> Bulletin Médical, May 1, 1898.

<sup>4</sup> American Journal of the Medical Sciences, June, 1899.

<sup>5</sup> Bulletin Médical, 1898, No. 83.

operated upon five and a half years before, in which the hypersecretion was immediately relieved, and has so continued since. The chlorate of sodium is recommended in doses of 2 grammes every two to four hours by Soufaut<sup>1</sup> for the relief of oversecretion as well as other functional nervous troubles. Six grammes of the phosphate of lime, taken while fasting, in the morning, is recommended by Leven.<sup>2</sup> At the same time he would allow the patient only one meal of solid food daily, and at other intervals would restrict him to milk. Ewald<sup>3</sup> reports a most successful treatment by rectal alimentation, lavage of the fasting stomach, followed by washing or spraying with 0.5 per cent. nitrate of silver solution every two hours, and 1 drachm of a 5 per cent. potassium iodide solution. He also uses the nerve sedatives.

The effect of saline waters upon hyperchlorhydria and oversecretion was discussed at the Seventeenth Congress of Internal Medicine, held at Carlsbad, April 11-15, 1899, in which Dapper<sup>4</sup> held that such waters are capable of increasing the active secretion of gastric juice in inflammatory conditions and in hyperchlorhydria, and that they also diminish the secretion of acid in hyperchlorhydria, but are contraindicated in serious peptic ulcer, Reichmann's disease, and gastrectasia. Gintl concludes that Glauber's salts do not increase the secretion of free hydrochloric acid, but that we are not justified in saying the same of waters that contain other salts beside the sodium sulphate. Iron has been suspected of acting injuriously in instances of hyperacidity—a position that is substantiated by the studies of N. Buzdygen.<sup>5</sup> While in lowered acidity the various ferruginous tonics are often tolerated by the stomach, the reverse is almost invariably true when the secretion is excessive.

**HYPOCHLORHYDRIA AND ACHLORHYDRIA.** J. Mitchell Clarke<sup>6</sup> reports a case of gastric anacidity in connection with neurasthenia, in which, after improvement of the patient's general condition, the hydrochloric acid secretion was restored. The view that achylia gastrica is merely the result of atrophy of the gastric mucosa is not so confidently held as it has been during the past few years. Prof. Lubarsch<sup>7</sup> reports the analysis of seventeen cases in which the secretory changes were permanent, but admits that only in the minority of cases does there follow serious anæmia or cachexia, and when these do succeed, it is because of motor insufficiency or the presence of serious constitutional disease, such as syphilis and tuberculosis. Rosenheim, in reviewing the monograph, believes that

<sup>1</sup> Bulletin Médical, 1898, No. 51.      <sup>2</sup> Journal de Medecine, 1898, No. 50.

<sup>3</sup> Transactions British Medical Association, Edinburgh meeting, July, 1898.

<sup>4</sup> Centralbl. für innere Med., 1899, No. 18.

<sup>5</sup> Wien. klin. Wochenschrift, 1898, No. 31.

<sup>6</sup> British Medical Journal, December 24, 1898.

<sup>7</sup> Monograph, Leipzig and Vienna, published by Franz Denticke.

the development of serious anæmia is more frequent even than Lubarsch admits. Martins believes in a simpler form of this disease, often found in neurasthenics, which is relatively harmless so long as the motor function of the stomach continues active. He thinks it possible that atrophy of the gastric mucosa may develop from this simpler form. These cases Rosenheim would class as instances of anacidity rather than achylia gastrica. Lubarsch believes that he has shown from particles of detached mucosa, obtained from the stomach washings, that a complete loss of function may result when only a partial destruction of the parenchyma is present. Such observations are necessarily deceptive, for it is well known that achylia gastrica may be present when specimens obtained, as above described, show the mucous membrane to be free from degeneration. Martins, Trundzack, Jaworski, Budish and other observers find that in simple anacidity the mucous membrane is so vulnerable that pieces showing no degeneration are easily scraped off with the soft stomach-tube. Gerhard, reported by Auerbach,<sup>1</sup> describes the case of a woman who died of pernicious anæmia, who had achylia gastrica for several months, and whose stomach showed no ascertainable changes save slight interstitial infiltration. The glandular canals were well preserved, which shows that achylia does not always depend upon adenia. Beside this, Einhorn has reported cases in which the secretion has returned; in one, after five years. I recall a case in which there was complete absence of hydrochloric acid and combined chlorides for nearly three years, and probably much longer, in which the secretion was restored and has remained normal since 1896. There really should be a differentiation between achylia simplex and achylia resulting from adenia. The distinction is not always easy, and sometimes requires long study. I believe with Martins, that in but few cases of achylia gastrica do we find evidences of putrefaction of the stomach contents, for the reason that the motor function is usually very active.

Goodale and Hewes<sup>2</sup> report a persistent urticaria of the tongue as a complication of achlorhydria. An exfoliative glossitis is not a rare accompaniment, but urticaria is very unusual.

Fleiner,<sup>3</sup> of Heidelberg, advises the use of chloral acid, a substance somewhat resembling the nutritive salts, and somewhat such preparations as somatose and nutrose as of great value in achlorhydria. It is apparently not known in this country.

Allen Jones<sup>4</sup> again calls attention to the association of diarrhoea with achylia gastrica. In a study of the relations of stomach and intestinal

<sup>1</sup> Münch. med. Wochenschrift, 1899, No. 8.

<sup>2</sup> American Journal of the Medical Sciences, April, 1899.

<sup>3</sup> Münch. med. Wochenschrift, January 3, 1899.

<sup>4</sup> Journal of American Medical Association, July 30, 1898.

affections, Joseph Wiczkowski<sup>1</sup> believes that the latter often cause gastric symptoms, such as anorexia, vomiting, and eructations. He refers to the fact before mentioned, that increased intestinal peristalsis leads to the decrease of gastric secretion, and that when the intestinal current is slow the gastric secretion is intensified. He concludes that in intestinal atony hydrochloric acid is increased, but decreased by the action of purgatives. In intestinal catarrh with diarrhoea there is absence of free hydrochloric acid in the stomach. These facts are interesting when we remember the frequency with which there develops a lenteric diarrhoea in cases of achylia gastrica. Tournier recommends large doses (from 3 to 5 grammes daily) of strong hydrochloric acid for the relief of diarrhoea in these cases. In two instances in which the diarrhoea was rebellious for eighteen months, it was quickly relieved by this dosage. He approves of large doses in nervous anacidity when there is no hyperæsthesia, which, by the way, is an important reservation. Tournier also refers to the fact that hydrochloric acid is the agent which stimulates the secretion of the pancreas, as shown by Sanotzky, Dolinsky and others, students of Pawlow; he also believes that hydrochloric acid favors the disappearance of mucus, which opinion he thinks is justified in the researches of Schmidt.<sup>2</sup> Einhorn does not favor the use of hydrochloric acid in achylia gastrica, but my own experience leads me to agree with Tournier. I have used it largely for ten years in these cases, and when associated with the intragastric application of electricity it forms the most satisfactory treatment with which I am acquainted. Ewald warns against following too strictly the indications of gastric chemistry in the treatment of neuroses, and says that he studies the whole affection rather than one phase of it.

**Sensory Neuroses.** An excellent study comes from Pick<sup>3</sup> on gastric hyperæsthesia, which he correctly says should be regarded and classified in the same category as cutaneous hyperæsthesia. There exists the unnatural irritability to chemical, mechanical, or thermic stimulation, which cannot be accounted for in any change of structure. The characteristic of the affection is that while fasting the stomach gives rise to no painful sensations. It is not a mere attenuation of gastralgia, but differs from it in nature. Ingestion of liquid or solid food may give rise to distress so great as to provoke vomiting. This is sometimes more likely to follow fluids than solids; still, some cases particularly resent solid food, and some, acids, though the acidity may be even below normal. The fatty acids may exercise a specially unpleasant effect. In other instances coarse foods or the seeds of fruit are particularly distressing. The

<sup>1</sup> Arch. für Verdauung Krank., 1898, Band iv., Heft 4.

<sup>2</sup> Deutsche Arch. für klin. Med., 1896.    <sup>3</sup> Wien. med. Wochenschrift, 1898, No. 34.

etiology may rest in some old stomach affection of long duration, or disturbed nutrition, chlorosis, neurasthenia, or exhaustion following table excesses. The chief symptoms are pain, eructations, pyrosis, nausea, and vomiting. The last-named symptom occurs immediately after the ingestion of food, and disappears after the stomach is empty. Alkalies give great relief in those instances in which acids are particularly resented; they sometimes cause pain and unnatural contraction of the stomach or cardia. The diagnosis is based upon the fact that the stomach contents are found normal, and by the exclusion of other conditions.

TREATMENT should be directed toward the relief of the general neurosis. Hydrotherapy, regular and appropriate alimentation—according to the symptoms—medical gymnastics, a change of scene or climate, and the rest cure are all of value. Special attention should be given to improving the mental state. Faradization is recommended by Pick, but I have found greater success from the continuous current, the positive electrode within the stomach; the cold spinal douche and the needle bath are also useful. Pharmaceutical remedies are of secondary importance. Menthol, cannabis indica, hyoscyamus, orexin, and large doses of bismuth are occasionally somewhat beneficial. Relief sometimes follows lavage with very hot water. Little real improvement results from medicated sprays or powders. They procure but temporary relief, and do not reach the seat of trouble which lies in the nervous system.

**Gastralgia.** True gastralgia is regarded by Clarke<sup>1</sup> as occurring less frequently than is supposed, and when present it usually appears in connection with hyperchlorhydria or anacidity.

TREATMENT. When the pain results from a neurosis, Clarke has found Fowler's solution in drop doses before meals a valuable remedy. Hirschkron<sup>2</sup> insists upon the importance of finding and removing the cause of the gastralgia. He is one of the few who recognize the importance of syphilis as a cause of the affection. In the treatment of hyperæsthetic gastralgia, he would use chloral and opium, as recommended by Ewald, and bromides, as recommended by Rosenthal. It must not be forgotten that there is a great penalty attending the use of these remedies, and they should be avoided, save when the pain is excessive. For pure gastralgia, Hirschkron speaks highly of exalgin and pyramidon. I have seen relief follow lactophenin and antipyrin, and sometimes large doses of quinine per rectum. When syphilis is the cause permanent relief follows the use of iodides and nothing else. The continuous electric current is of positive value, both for the mitigation of the pain and preventing its return.

<sup>1</sup> Maryland Medical Journal, vol. xli., No. 5.

<sup>2</sup> Wien. med. Blätter, 1898, Nos. 47 and 48.



**Dietetics.** The frequency of meals and the quantity of food taken are questions too frequently determined by conventionality and habit. Dr. Rabagliati<sup>1</sup> reaches very sensible conclusions, based on his experience in feeding patients twice instead of three to six times daily. He believes that a large proportion of sickness is produced by too frequent and abundant feeding, and criticises King Chambers' assertion that three pounds avoirdupois is a reasonable daily average of food. He thinks that one pound is nearer the proper quantity, and recognizes a starvation due to overrepletion; he gives rheumatism as a type. Henry Wald Bettmann<sup>2</sup> protests against the theory that each man is the best judge of his own diet, and makes an equally strong protest against overrestriction in eating, stating that many patients are actually suffering from slow starvation through improper medical advice. An exclusive milk or beef diet will eventually lead to waste or anæmia if the patient is kept at work. If it is required, the exclusive diet should be as brief as possible. He also protests against the taking of large amounts of hot water, believing it harmful in cases of atonic dyspepsia, and only safe when the patient is well nourished, as then there is strong gastric motility. Both these contributions are valuable and timely. Many victims of dyspepsia will recover when meals are limited to breakfast and late dinner. The stomach requires time for recuperation, which is impossible if hearty luncheons are indulged in. The stomach-tube has shown that Bettmann is correct in the theory that each man is not the best judge of his own diet, and also in stating that a restricted diet, as usually practised, is often erroneous. The extremes are to be criticised. A healthy stomach may become hyperæsthetic and resentful, if for a long time it is only required to manage soft and easily digested foods. Here, as elsewhere, strength comes from use; but the other extreme is quite as harmful, and the digestive energy is squandered and weakened and poor digestion follows the indiscriminate and irregular eating of irritating and indigestible foods. As an example of the tolerance to which the stomach has been educated may be cited a most extraordinary instance.<sup>3</sup> A man, thirty-two years old, had for years followed the practice of swallowing glass and stones as an exhibition. He had taken nine and a half pounds of stones on a single occasion, without pain or discomfort. He was ultimately attacked with severe pain, was sent to a hospital, and sixty stones were removed from the rectum by means of the fingers and a scoop, after which he made a good recovery.

On the practice of drinking hot water, so much indulged in without definite reason, it should be said that there is authority for believing that

<sup>1</sup> British Medical and Chirurgical Society; British Medical Journal, December 10, 1898.

<sup>2</sup> Cincinnati Clinic, December, 1898.

<sup>3</sup> London Lancet, March, 1899.

very hot water acts as a temporary gastric stimulant. Warm water soothes an irritable stomach, and the emesis supposed to follow its taking is very largely psychical in its effect.

L. Duncan Bulkley<sup>1</sup> contends that milk taken an hour before meals, unmixed with other foods and unpeptonized, is absorbed at once into the blood without undergoing the process of digestion. If not already alkaline a little bicarbonate of soda should be added to the milk, and it is necessary for the patient to lie down for an hour after taking it. He cites Drs. A. H. Smith, Marion Sims, Frank Hamilton, John C. Dalton, and Wesley Mills in support of his theory. It is a fact that milk given in this way disappears very rapidly from the stomach. It is also known that unpeptonized milk is much more quickly absorbed from the rectum than is milk peptonized.<sup>2</sup> These facts would seem to favor Bulkley's theory; but, on the other hand, it is well known that if milk is removed from the stomach shortly after it is swallowed it shows coagulation from the effect of the lab-ferment. It is probable that digestion goes on so rapidly, and to the patient so unconsciously, that it has given rise to Bulkley's suspicion.

Mathieu holds that raw eggs constitute the best means of procuring rectal alimentation. On this point Catillon<sup>3</sup> does not agree, and finds that there is a loss of weight in animals thus nourished. But if the eggs be peptonized they may almost replace alimentation by the mouth. Several new food preparations are claiming a place. Tropon is recommended by Rudolph,<sup>4</sup> also by Frohmer and Hoppe.<sup>5</sup> Eucasin is recommended by Toppel.<sup>6</sup> These substances are said to replace somatose, and are found to be much cheaper.

**Medication and Digestion.** The recent studies of digestion have thrown valuable light on the question of medication by the stomach. An article by Moritz<sup>7</sup> is of great value in this connection, as is also an article in the French on the hour of medication.<sup>8</sup> Moritz points out that the resorptive power of the stomach has been overestimated, and for many drugs amounts to nothing. The question is, therefore, how rapidly the drug will be propelled into the intestines where resorption occurs. Von Mering has shown that water and weak saline solution leave the stomach rather quickly—one litre disappearing in from one-half to three-fourths of an hour; a glass of water disappearing in twenty minutes—but when the water is acid or charged, or when it appears in the form of soups, milk, or beer, the stomach is stimulated, secretion

<sup>1</sup> Journal of American Medical Association, December 17, 1898.

<sup>2</sup> L. Aldor. Bulletin Médical, March 20, 1898.

<sup>4</sup> Münch. med. Wochenschrift, January 10, 1899.

<sup>6</sup> Zeit. für Psychiatri, 1897, Band liv.

<sup>7</sup> Münch. med. Wochenschrift, 1898, No. 48.

<sup>8</sup> Journal de Medecine de Paris, August 28, 1898.

<sup>3</sup> Ibid., 1898, No. 51.

<sup>5</sup> Ibid.

begins, the pylorus closes, and absorption is delayed. Therefore, water taken on an empty stomach disappears more quickly than when taken with food. In order to procure the most rapid effect of the drug it should be given on an empty stomach, dissolved and largely diluted with water. Drugs that are insoluble in the stomach, such as salicylic acid, are best given in glutoid capsules (gelatin hardened by formaldehyde) that are digested in the intestine only. In case of gastric atony and dilatation it is futile to administer drugs by the mouth and expect a prompt and reliable action. Chloroform, naphtol, saccharine, and most metallic salts seriously interfere with the digestive process, and sometimes are sufficient to practically prevent it; they should be given, therefore, some time after rather than just before meals. Oil should not be administered before meals, for it coats the mucosa and prevents secretion.

Wirschillo, in *Vratch*,<sup>1</sup> reports a case of iodism in which cutaneous eruption had its counterpart in the pyloric region of the stomach which led to an ulcerative process, the first report of the kind known.

Wine should follow meals and bitters should precede them. The latter exert their effect particularly upon the motor functions. Potassium iodide when largely diluted disturbs digestion least if given on an empty stomach.<sup>2</sup>

It should be remembered that as a class women drink very little water—largely a matter of habit and to save inconvenience. It is important to bear this in mind in considering the question of digestion as well as medication. Algeron<sup>3</sup> recommends water containing chloride of sodium in atony of the stomach and large intestine, and the alkaline-saline waters in chronic gastritis and in hepatic disease. All forms of mineral waters are contraindicated in dilatation of the stomach. Editorially, the *International Medical Magazine* opposes the taking of large amounts of alkaline or saline waters in gastric anacidity. Both the secretory and the mechanical activity is believed by J. Latowski<sup>4</sup> to be increased by the use of Marienbad water.

**Vomiting.** Vomiting sometimes occurs as a cyclic affection. Here the vomiting is only one feature in an interesting syndrome. It is well described by Whitney.<sup>5</sup> The affection usually occurs in delicate children, and the attacks appear at intervals of from two to three months and last for a few days, after which the child is in usual health. The attacks are preceded by a prodromal period in which lassitude, a coated tongue, offensive breath, rings about the eyes, and gastric discomfort are

<sup>1</sup> January, 1899.

<sup>2</sup> Neumann. Wien. med. Blätter, 1899, No. 6.

<sup>3</sup> Münch. med. Wochenschrift, October, 1898, No. 46.

<sup>4</sup> Przegląd Lekarski, April 15, 1899, vol. xxxviii., Nos. 14 and 15.

<sup>5</sup> Archives of Pediatrics, November, 1898.

the chief symptoms. The attacks come on abruptly, with severe and uncontrollable vomiting, made worse by taking food or drink. In the cases that I have seen there was an elevation of temperature, and the gastric contents showed a temporary excess of free hydrochloric acid. The attack is followed with great prostration, but the convalescence is rapid. Some observers state that the paroxysms recur regardless of dietetic indiscretion or psychical disturbance. I have found that over-fatigue is apt to precipitate an attack in those predisposed to the affection. I have known alkaline sedatives, like the milk of magnesia, to afford some relief, but usually nothing does much good until the storm exhausts itself.

**NERVOUS VOMITING.** For this form of vomiting, menthol in 1 grain doses, with sodium bicarbonate, is recommended by Meisl.<sup>1</sup> Mitchell<sup>2</sup> recommends for this condition the application of compresses wrung out of ice-water and changed every minute for a quarter of an hour. For the **VOMITING AFTER ANÆSTHESIA**, Gunby<sup>3</sup> recommends lavage, to be practised at the close of the anæsthesia. His patients, who apparently took chloroform only, regained consciousness without nausea or gastric discomfort. He employs a gag, and then uses the stomach-tube in the ordinary way, before consciousness is regained.

## THE INTESTINE.

**Methods of Examination.** As an assistance to the physical examination of the abdomen, Fuchs<sup>4</sup> advises the injection of a litre of saline solution, which renders the bowels more accessible to examination. After this, inspection will often enable one to determine the location of the bowel and its relation to other parts; it also assists in the practice of palpation and percussion. It renders it more easy to make out the relation of the liver, spleen, and kidneys, and the lower border of the stomach is more easily recognized.

**Appendicitis.** In an interesting résumé of his study of 1400 fatal cases of appendicitis, collected by himself, James F. Mitchell<sup>5</sup> believes that professional opinion has gone to the extreme in believing that foreign bodies, aside from fecal concretions, are not found in the appendix. Of these cases 7 per cent. contained true foreign bodies, the character of which was extremely varied and interesting. Pilliet<sup>6</sup> states that he has shown that the histological characteristic of non-calculus

<sup>1</sup> Therap. Wochenschrift, September 19, 1897.

<sup>2</sup> Virginia Medical Semi-monthly, April 14, 1899.

<sup>3</sup> Medical News, January 21, 1899.

<sup>4</sup> Zeit. für klin. Med., 1898, Band xxxvi., Heft 2.

<sup>5</sup> Johns Hopkins Bulletin, March, 1899.

<sup>6</sup> Bulletin Médical, 1898, No. 4.

appendicitis is the disappearance of the secreting glands of the appendix through strangulation of the lymphatic tissues ; in calculous appendicitis it is otherwise, the glands of Lieberkühn are preserved and often hypertrophied, and he believes that it is a mucous secretion that leads to the production of calculi. That such secretions are formed in the appendix is shown, according to Pilliet, in the fact that they contain no trace of skatol.

The occurrence of appendicular colic as the result of pressure upon the appendix exercised by the enterolith in the cæcum is described by L. Golbach.<sup>1</sup> The attack of pain lasted so long as the stone pressed upon the appendix, but when it changed its location the attacks subsided ; the appendix itself was healthy. The concurrence of appendicitis and la grippe has led Faisans<sup>2</sup> to conclude that under certain circumstances the latter may produce the former, and that this is rather the rule than the exception. He cites two reasons to substantiate his theory : First, the extraordinary frequency of appendicitis during the past ten years, and, second, that each epidemic of la grippe is accompanied by an increased number of cases of appendicitis.

Edebohls<sup>3</sup> has found in his cases of appendicitis wandering kidney in 60 per cent. By his method of palpating the appendix he ascertained that 4 per cent. of all women had appendicitis, and 3.5 per cent. had appendicitis with symptoms of movable kidney. The appendicular trouble is usually of the chronic form, and, he thinks, depends upon the fact that the right kidney presses upon the head of the pancreas, thus compressing the superior mesenteric vein against the vertebræ, which results in a venous stasis of the appendix. In proof of the theory he reports twelve cases cured by nephropexy. Some cases of appendicitis have a close resemblance to renal colic. Dieulafoy reports a case having had three attacks of pain, in which the diagnosis rested between renal and hepatic colic. On the last occasion it was observed that there was some tenderness over the cæcum and severe testicular pain. Dieulafoy doubted the diagnosis of renal colic, on the ground that there was no tenderness over the kidney, and because the testicular pain gradually increased in intensity and as gradually subsided, instead of the abrupt manner usual to renal colic. Upon operation there was discovered a swollen and ulcerated appendix lying upon the cæcum and adherent to the psoas iliacus. In this situation it exerted pressure on the genito-crural nerve, irritation of which is the source of pain in true renal colic. Cases of appendicitis in which there is progressive emaciation and cachexia, and the development of a hard tumor in the right

<sup>1</sup> Prag. med. Wochenschrift, 1898, No. 16.

<sup>2</sup> Bulletin Médical, 1899, No. 25.

<sup>3</sup> Centralbl. für Gyn., 1898, No. 40 ; Journal of American Medical Association, January 7, 1899 ; also Transactions of Medical Society of State of New York, 1899.

iliac fossa, may be mistaken for malignant disease. After a long period the mass softens, and possibly may be evacuated. Eight cases are reported by Lequen and Beaussenet.<sup>1</sup> The same subject is discussed by Pauchet,<sup>2</sup> who says that the clinical features of this type of the disease are rapid emaciation, enfeeblement, cachexia, and a hard, reniform and scarcely painful tumor in the right iliac fossa. There are chills and sweats at night, and rapid increase in the size of the tumor. He insists upon the importance of a slight temperature, the previous history of digestive disturbance and attacks of appendicitis. Cancer of the cæcum is painless; there is a history of melæna, the occurrence of more or less obstruction, and the tumor is bosselated, mobile, and irregular. Osteosarcoma of the iliac fossa is hard and fixed to the basin. Malignant growths of the mesentery occupy the umbilical region and are movable in all directions. Barling<sup>3</sup> reports the case of a youth, aged seventeen years, who had suffered six attacks of right abdominal pain, with vomiting and constipation, or diarrhœa, and with induration in the right iliac fossa. It was diagnosed as recurrent appendicitis and operated upon. The appendix was found absolutely healthy and free from adhesions. The outer half of the cæcum and ascending colon were hard and densely thickened; there were no adhesions to the internal, anterior, or external surface of the bowel, but there were some adhesions posteriorly. No pus was found, and the patient made a good recovery.

Closure of the appendicular canal, forming an infectious sac, is regarded by Dieulafoy<sup>4</sup> as practically constituting the disease appendicitis. This author, in an excellent article, reviews his experimental work with Caussade. He concludes that appendicitis is not only infectious, but that it is equally toxic. They found that animals inoculated with sterilized cultures made from a closed cavity of appendicitis for the most part died of intoxication without showing evidences of infection, whereas the sterilized cultures from open parts of the appendix proved comparatively harmless when injected into animals. Dieulafoy regards the appearance of icterus in the course of appendicitis as of great prognostic importance, which, he says, evidences hepatic complications. It may result from infection or from intoxication. When icterus results from intoxication the tint is light, appears on the first day of the disease, and, while the urine shows the absence of biliary pigment, there is the presence of urobilin and brown pigment. The other form of icterus in appendicitis is consecutive to infection of the organ by the colon bacillus. Infectious jaundice consecutive to appendicitis the author considers mortal, whereas that from intoxication is of less importance; but the toxicity

<sup>1</sup> *Revue de Gyn. et de Chir. Abdominale*, 1898, No. 2.

<sup>2</sup> *Gaz. de Med. de Picardie*, December, 1898.

<sup>3</sup> *British Medical Journal*, March 25, 1899.

<sup>4</sup> *Bulletin Médical*, 1898, No. 90.

may be intense, even fatal. These views of Dieulafoy are confirmed by the studies of Rennon.<sup>1</sup> Jaboulay<sup>2</sup> speaks of a form of appendicular infection that he calls putrid appendicitis, in which almost all of the microbic flora may be found and which have a remarkable tendency to invade other tissues and organs. One of the author's cases drained by the rectum recovered, but those treated by laparotomy died, even when there was but slight apparent infection. Dieulafoy<sup>3</sup> calls attention to what he calls "the treacherous calm" in appendicitis. It is often not a sign of improvement, but sometimes coincides with the beginning of grave lesions, gangrene, septicæmia, or diffuse peritonitis. If careful examination is made, it will be seen that the calm is not complete, but that there is a continuation of tympanites, muscular rigidity, acceleration of the pulse, and urobilin and albumin may be found in the urine, even though the temperature has fallen.

That lack of accord in the patient's condition and the state of the appendix has been studied by Miss von Mayer,<sup>4</sup> an interne of Prof. Roux, of Lausanne. She concludes that there is no concordance between the subjective state of the patient and the real state of the appendix, and that the physician cannot allow himself to be guided entirely thereby. She says that when there has been observed a first crisis, with a palpable exudation, an operation should be performed during the interval. Thus may be avoided the severe régime, fear of a subsequent attack, and the incapacity for hard work or strain.

That disappointing affection called by some pseudo-appendicular colic has led to the embarrassment of many. Folet,<sup>5</sup> of Rennes, reports a case in a patient operated upon after five attacks of appendicitis with apparent cure. However, the patient still continued to experience crises identical to the attacks previous to the operation. The removed appendix was red, lardaceous, and partly transformed into a closed cavity; there were no adhesions. The patient was not hysterical, and there was no evidence of pseudo-membranous enteritis. As an indication for immediate intervention, Routier<sup>6</sup> regards paralysis of the intestine the most important phenomenon. At the Seventieth Meeting of German Physicians and Naturalists, Riedel reported statistics on 152 cases of appendicitis, of which 11 were local tuberculosis and 1 was a perityphlitis without appendicitis. Of the 120 cases, 97 were suppurative, of which 92 were perforated. Examination of the specimens showed that there was no relation between the lesions observed and the clinical manifestations.

In the medical treatment of appendicitis, Ludwig Herzog<sup>7</sup> has the

<sup>1</sup> Bulletin Médical, 1898, No. 45.

<sup>2</sup> Ibid., 1898, No. 77.

<sup>3</sup> Ibid., 1899, No. 12.

<sup>4</sup> Ibid., 1898, No. 78.

<sup>5</sup> Ibid., 1898, No. 89.

<sup>6</sup> Ibid., Jan. 7, 1899.

<sup>7</sup> Zeit. für klin. Med., Band xxxvi., Heft 3 and 4.

courage to recommend strongly the use of opium, for the reason that it quiets peristalsis, and is, therefore, useful in permitting the walling off of the abscess and in preventing the rupture of adhesions that may already have been formed. This, with a limited diet and complete rest in bed for some time after the attack seems to have entirely subsided, he regards as positive indications. Most surgeons prefer to operate during the interval, and yet there has been an apparent misconception of the physician's rôle during the attack. Without a very definite purpose, opium, antiseptics, and salines are given in such a way that medicine falls into discredit. Herzog does well in pointing out the importance of opium, but it should not be given timidly. The object is to procure complete physiological rest until the attack subsides; then an operation loses its terrors.

**Intestinal Obstruction.** The gangrene and ulceration from outside pressure at the seat of strangulation is not, according to Kocher,<sup>1</sup> the sole cause of death. In the majority of his post-mortems there have been found lesions of the intestine, above the seat of obstruction, consisting in circumscribed necrosis of the mucosa, at points going on to ulceration and even perforation. He found that the same result may follow artificial overdilatation of that part of the bowel by injections of gas or fluid, without the slightest interference with mesenteric circulation. Venous stasis is shown in the lividity of the bowel; ecchymosis appears, the nutrition is altered, and the protective influence of the epithelium is lost. When this epithelial barrier is removed the absorption of toxic products and the migration of bacteria at once begins, and without prompt intervention the patient may be expected to succumb either from general intoxication or perforation.

Following strangulation of a hernia which has been successfully reduced, important accidents may happen, according to Luksh.<sup>2</sup> Among these are hemorrhage and secondary stenosis, reported sometimes to occur after an interval of apparent health. Hemorrhage follows twenty-four hours after, but sometimes as late as six or seven days, in the meantime the patient having natural evacuations. The early hemorrhage is supposed to result from congestion, and the later hemorrhage to result from sloughing of gangrenous areas of mucous membrane. A favorable prognosis may be made in the early hemorrhage, but not in the late. These observations of Luksh are explained by Kocher's experiments and post-mortems, and demonstrate the peril to which patients are subjected who are given purgatives and are allowed to wait while the necrotic processes are going on within. Nothing can be gained by delay, while the success of surgical intervention is hazarded if the operation is postponed so long

<sup>1</sup> Quoted in *British Medical Journal*, October 29, 1898.

<sup>2</sup> *Wien. klin. Wochenschrift*, October 20, 1898.



that the intestinal mucosa has lost the power of opposing infection and toxic absorption. So long as the epithelium of the intestinal mucosa remains intact, infection, as shown by Opitz,<sup>1</sup> is impossible.

Diaphragmatic hernia is sometimes a most obscure cause of obstruction and the diagnosis is rarely made before death. Gontrand<sup>2</sup> reports an instance of this lesion occurring as a congenital defect. There was a left anterior perforation at the border of the costo-diaphragmatic hiatus. It was oval and 3 cm. in diameter. I once saw such a case developing in an adult, although he had no previous injury or illness, and it is possible that it was secondary to some congenital weakness. L. F. McDowell<sup>3</sup> reports a case occurring in a muscular, well-built Kaffir, in which the hernial sac had entered the pericardial cavity. The opening in the diaphragm was found to be about the size of a sixpence, smooth-edged, and situated in the tendinous part. There was, in this case, no history of injury or accidental strain.

Obstruction from volvulus may occur even in the stomach, as reported by Berg.<sup>4</sup> Among the causes of obstruction is the presence of foreign bodies; the instance of a large gallstone ulcerating from the gall-bladder into the intestine and causing acute obstruction is reported by C. A. Morris.<sup>5</sup> Among the causes of obstipation and serious obstructive symptoms in the aged, Matthews<sup>6</sup> states that an almost exclusive oatmeal diet is one. Two cases are reported. In the first a mass as large as a foetal head was found impacted in the sigmoid. This is a warning against oatmeal as a diet in intestinal atony. A curious case is reported by Fritz<sup>7</sup> of a child suffering from apparent intestinal invagination. Nevertheless, intestinal irrigation was practised and castor-oil given, when there was passed per rectum the cadavers of two mice. No explanation of the presence of these animals in the intestine was offered, although it is stated that the child was not intelligent.

**INTUSSUSCEPTION.** An interesting discussion on this subject occurred in the Clinical Society of London,<sup>8</sup> in which Mr. Langton stated that in acute cases injections should not be tried, as reduction may not be complete, and valuable time is lost, while in chronic cases rupture may take place under very low pressure. Dr. Guthrie observed that injection or insufflation should be left to cases not more than forty-eight hours old, and with all the symptoms only slight in degree. A case that was

<sup>1</sup> Bulletin Médical, 1899, No. 27.

<sup>2</sup> Lyon Medical, 1898, No. 34.

<sup>3</sup> British Medical Journal, January 7, 1899.

<sup>4</sup> Centralbl. für Chir., September 3, 1898.

<sup>5</sup> British Medical Journal, January 7, 1899.

<sup>6</sup> North Carolina Medical Journal, January 5, 1899.

<sup>7</sup> Münch. med. Wochenschrift, 1898, No. 52.

<sup>8</sup> British Medical Journal, May 21, 1898.

relieved by injection was presented by Mr. Silcock, who agreed that injection was usually not to be recommended. Mr. Kellock, on the other hand, thought that an abdominal incision in a very small child was a serious matter, and that many cases proved fatal after two or three days without serious symptoms until the day of death. On this point Dr. Lees observed that he had seen many cases recover under slight irrigation, and while this sometimes failed he had also seen failure after subsequent laparotomy. The present accepted view would seem to be that expressed by Murray,<sup>1</sup> who points out that the danger of attempt at reduction by injections is about as great as the danger of operations for the relief of intussusception, and that if relief does not follow the early attempts by injections an operation should not be delayed. When injection is tried the recommendations of Johnson<sup>2</sup> may be followed. He emphasizes the justice of the claim that electricity carried into the colon through saline solution, injected as an enema, is a very important measure, and overcomes obstruction in many obscure cases.

**Idiopathic Dilatation of the Colon.** Concerning phantom tumor and idiopathic dilatation of the colon, Fitz,<sup>3</sup> of Boston, says they are frequently one and the same thing. He refers to the older views held by Bright, Addison, Gull, and Greenhow, who maintained that phantom tumors were always seen in hysterical women. J. M. Da Costa recognized the fact that the phenomenon was not necessarily dependent upon hysteria, as he had observed "these tumors in men who were not very impressionable." In 1884, Gee called attention to "idiopathic dilatation of the large intestine," and he thought the condition was caused by "mere constipation and retention of wind." So-called idiopathic dilatation of the colon seems to occur without organic or mechanical cause other than fecal accumulation. It becomes so marked that distress, deformity, and death not infrequently follow. Two types of the affection are considered—one beginning in infancy, the other in adult life. One of Osler's cases was an infant, seven months old, who had had only five or six evacuations before coming under observation. Peacock and Hughes, Walker and Griffith, Rolleston, Howard and Formad all reported cases varying in age and degree. Fitz adds the case of a girl, aged fourteen years, who was under his care at the Massachusetts General Hospital in 1894. She had been constipated all her life, and her abdomen was much enlarged, measuring thirty-one inches in circumference. "It was tympanitic throughout, except in the right iliac fossa, where there was a diffused dulness." An enema of five pints of water caused dulness on percussion in the left half of the abdomen. The case

<sup>1</sup> London Lancet, November 19, 1898.

<sup>2</sup> Journal of American Medical Association, October 28, 1898.

<sup>3</sup> American Journal of the Medical Sciences, August, 1899.

was lost sight of. Treves maintains that there exists an actual mechanical obstruction in young children, due to congenital defects in the lower part of the bowel, and he successfully removed the descending colon and sigmoid flexure for the relief of a dilated colon. In the cases that may "conceivably" be called idiopathic, the affection begins in a functionally defective expulsive power, which leads to fecal accumulation and dilatation of the sigmoid flexure, and this in turn offers an increasing impediment the greater it becomes aided by the dilatation and kinking. Fitz finally reports the case of an unmarried woman, aged thirty-seven years, who gave the history and showed the signs and symptoms of dilated colon, who was operated upon by M. H. Richardson. The enlarged sigmoid flexure was removed and convalescence progressed uninterruptedly. From these observations it follows that there are evidently some cases of enlarged pendulous abdomen depending upon dilatation of the colon that may be relieved or cured by surgical intervention. It would appear that with an early diagnosis appropriate medical treatment might also yield good results.

**Dysentery.** Some confusion has arisen between tropical and amœbic dysentery; these are not necessarily one and the same thing. Buchanan<sup>1</sup> reports the results of a large number of cases occurring in India in which post-mortem examinations were held and there was found but one case of liver abscess. He believes that the colon bacillus and the bacillus pyocyaneus are more often the cause of tropical dysentery than the much-talked-of amœba. On the other hand, Ciechanowski,<sup>2</sup> who made many examinations in dysentery, found the amœba either in the feces or in the tissues, and concluded that none of the colon bacilli produced the characteristic changes in dysentery. The streptococci, however, apparently play a distinct rôle in the development of the disease, associated with some unknown causes. H. F. Harris<sup>3</sup> reports that thirty out of thirty-five patients suffering from amœbic dysentery had been in the habit of drinking surface-drainage water from wells, a statement that confirms the views previously expressed by Councilman and Lafleur. A case of amœbic dysentery associated with noma is reported by E. R. Lecount.<sup>4</sup> Further evidence of the arthritic complications of dysentery is supplied by Remlinger,<sup>5</sup> who described two forms: one, dry, in which there is polyarticular pain affecting different joints with extreme rapidity and unaccompanied by effusion; the other, in which effusion occurs and is much more rebellious to treatment.

<sup>1</sup> British Medical Journal, September 24, 1898.

<sup>2</sup> Centralbl. für Bacteriologie, 1898, Nos. 11 and 12.

<sup>3</sup> American Journal of the Medical Sciences, April, 1898.

<sup>4</sup> Philadelphia Medical Journal, December 7, 1898.

<sup>5</sup> Revue de Médecine, September 10, 1898.

**TREATMENT.** Aspiration and the administration of antipyrine were used by Remlinger in his cases. Sandwith<sup>1</sup> advocates, in acute dysentery, the treatment by large enemata, in which he would use a 1 : 5000 solution of quinine, or weak solutions of cupric sulphate. In discussion, Dr. Osler expressed his disfavor of the method, because of the pain and exhaustion that it caused. Davidson said that the essentials of the treatment were rest, warmth, free purgation, and a bland diet. He advises ipecac early and intestinal antiseptics late. Dr. Prentice, of Central Africa, found that the best success followed the use of castor-oil, to be succeeded by tincture of opium, and that by ipecac. Crombie, of the British Army, remarked that the great majority of so-called cases of dysentery were really merely rectal catarrh. These cases, he thought, provided the bulk of the evidence in favor of ipecac; in chronic cases with extensive ulceration ipecac was worse than useless, but in true dysentery of the acute type it was of signal service. He advised chloral previous to the administration of ipecac, and while believing in hot enemata, discountenanced the method as a systematic practice. Maberly<sup>2</sup> reports success in the treatment of 100 acute and chronic cases of dysentery with *Monsonia burkei* and *Monsonia ovata*. Arthur Foxwell<sup>3</sup> recommends the de-emetinized ipecac method as of great use in dysentery. This is quite contrary to the views of the French, who employ the drug for its emetic properties. Leahy, of Hyderabad, uses one-half ounce of saturated solution of magnesium sulphate and twenty drops of dilute sulphuric acid, repeated every hour or two.

Foxwell refers to the surgical method of treating colitis by the performance of a lumbar colotomy. This was once done with success by Mayo Robson. At the meeting of the Post-Graduate Clinical Society, Rose,<sup>4</sup> of New York, stated that for fifteen years he had been practising the inflation of the rectum and colon with carbonic acid gas as a means of relief for dysentery and colitis.

**Mucomembranous Colitis.** This condition, which has been regarded from so many points of view, is considered by De Langenhagen,<sup>5</sup> after having studied 130 cases, to be the result of a neuro-arthritic diathesis which leads to intestinal atony and prolonged constipation. Max Einhorn<sup>6</sup> adverts to this disease of the colon, and thinks that it is produced by increase in secretion of the glandular cells, the result of long constipation. He thinks that slight inflammatory changes may be secondary to this, but refers the disease to a neuropathic origin. Of Einhorn's twenty

<sup>1</sup> British Medical Journal, September 24, 1898.

<sup>2</sup> London Lancet, July 16, 1898.

<sup>3</sup> Birmingham Medical Review, January, 1898.

<sup>4</sup> Post-Graduate, vol. xiv. p. 28.

<sup>5</sup> Bulletin Médical, 1898, No. 18.

<sup>6</sup> Arch. für Verdauung Krank., 1898, Band iv., Heft 4.

cases, twelve had enteroptosis; in five cases there was typical achylia gastrica, which, he thinks, shows a relation between these diseases, and also testifies that they are both probably due to nervous influences. Bardet<sup>1</sup> says that the condition is a symptom common to many abdominal diseases, and he opposes Mathieu's contention that it is usually a symptom of hyperchlorhydria. The latter makes a suggestive observation in comparing mucomembranous colitis to eczema, not claiming that they are identical, but holding that there is an affinity between the two conditions. Both are subject to exacerbations, often brought on by the menstrual state and alterations in the general nervous condition, to which he might have added irregularity in diet and local irritation.

**TREATMENT.** In treating this condition, we must bear in mind the neuropathic element in the etiology as well as the sources of local irritation, such as enteroptosis, intestinal adhesions, etc. Von Noorden's plan of diet is to use foods with a large amount of cellulose and detritus, such as coarse breads, vegetables, fruits with seeds, etc. In fifteen cases so treated, seven were cured and eight unimproved. Einhorn recommends a rich mixed diet, and during severe attacks, rest in bed with injections of peppermint-water. In the interval between attacks, he recommends the treatment devised by Kussmaul and Fleiner—that is, the introduction per rectum of from one-quarter to one-half litre of oil, at the temperature of the body. This should be used at night and retained until morning. After continuing this for three weeks the frequency of the injections should be lessened. This method has sometimes proved very useful in my hands. Lawrie<sup>2</sup> reports a case of twelve years' duration radically cured by colotomy.

**Enteroptosis.** J. J. Putnam<sup>3</sup> calls attention to the relation existing between enteroptosis, achylia gastrica, and melancholia. Putnam's idea apparently is that all these conditions may exist as the result of an unstabled nervous equilibrium, and that each has a neuropathic basis. The importance of maintaining proper intra-abdominal pressure through strengthening of the abdominal parietes is insisted upon by H. Illoway,<sup>4</sup> who also calls attention to the delicacy and often relative weakness of the mesenteries that hold in place the abdominal viscera. He thinks that the mesentery fails in function as the abdominal walls relax in individuals predisposed to splanchnoptosis.

**Constipation.** The problems connected with constipation in young children are considered by T. C. Martin.<sup>5</sup> He points out that often violent but futile efforts at evacuation in infants depend upon anatom-

<sup>1</sup> Bulletin Médical, 1898, No. 92.

<sup>2</sup> British Medical Journal, November 5, 1898.

<sup>3</sup> Boston Medical and Surgical Journal, November 17, 1898.

<sup>4</sup> American Journal of Obstetrics, September, 1898.

<sup>5</sup> Gaillard's Medical Journal, October, 1898.

ical peculiarities. First, the infant's lower gut is muscularly deficient; second, the mobility of the intestine within the abdomen is obstructive to defecation; third, in infants the rectal valves are obstructive; fourth, the infant's anus is not sufficiently expansive. He shows from experiments that the mesoperitoneum in the adult is short compared with that in the infant. The intestine of the adult is slightly tortuous, while that of the infant is much more angulated. A suggestive contribution on the relation between constipation and renal conditions is made by Kobler,<sup>1</sup> who states that in suspected cases of obstruction of the bowels, and in cases that alternate between constipation and diarrhoea, he has found that during the period of constipation there appeared tube-casts, red and white corpuscles and renal epithelium in the urine, usually without albumin. This condition disappeared with relief from constipation. He found similar results when from various causes colic developed. He suggests that the presence of renal structures in the urine in the case of peritonitis may have a similar cause. It is possible, as he suggests, that this may result from a reflex spasm of the vessels, and that it is more the result of pain than of mere constipation.

**TREATMENT.** In the treatment of constipation attention has been directed to two forms: one that depends upon an atonic state of the muscular coats, and a second upon a spastic state. In the former condition Kackel Jeannot<sup>2</sup> recommends a coarse diet, abdominal massage, and hydrotherapy. In the tonic or spastic form he uses a bland but nutritious diet, and the application of hot compresses over the epigastrium and a gentle cold shower over the abdomen. Cornet<sup>3</sup> recommends omitting the use of purgatives until they are absolutely necessary. He would pay special attention to regularity in hours and habits of defecation. The patient should sit on a low stool, so that the thighs press against the abdomen, thus assisting the muscles in the act of defecation. For transient conditions he would use intestinal lavage. He believes that injections are indicated only when there is an excessive collection of fecal matter in the lower bowels. In such cases dietetic treatment does not avail. He speaks highly of the injections of oil, as recommended by Kussmaul and Fleiner. In an excellent article by Lockwood,<sup>4</sup> the "Neptune girdle" is recommended in constipation depending upon the spastic state. This girdle consists in the application at night of hot fomentations to the abdomen, retained by means of a binder; sodium bromide and belladonna he also found useful in these cases. The Homburg treatment has enjoyed a reputation, and is described by

<sup>1</sup> *Wien. klin. Wochenschrift*, 1898, No. 20.

<sup>2</sup> *Deutsche med. Wochenschrift*, 1899, No. 1.

<sup>3</sup> *International Medical Magazine*, November, 1898.

<sup>4</sup> *Medical News*, December 10, 1898.

Hans Leber.<sup>1</sup> The method includes hydrotherapy and a somewhat complicated dietary with regulation of habits. Berne<sup>2</sup> believes that massage of the gall-bladder, by means of which an active biliary flow is established, is of value in many cases of constipation. The continual use of laxatives is objectionable, and may often be omitted by carrying out a well-directed campaign of diet, hydrotherapy and corrected habits. O. Schilling<sup>3</sup> advises the injection of one-fourth of a litre of tepid water once a day, at which time the bowel should be emptied, but desire for stool at other intervals should be resisted. After the fourth week the patient should defecate without the assistance of the enema. If the case is not relieved in from four to six weeks he uses a large amount of warm water, to soften the fecal matter and move the bowels, and subsequently uses a small injection of cold water as a stimulant.

**Intestinal Auto-intoxication.** The question of intestinal auto-intoxication was discussed at the Sixteenth German Congress of Internal Medicine, held at Wiesbaden, 1898, by Muller,<sup>4</sup> of Marbourg. A distinction is made between the toxæmia resulting from intracellular changes of the organism and that which arises from saprophytic bacteria, tenants of the stomach and intestines. The latter condition may be regarded as analogous to alimentary intoxication often following the taking of unwholesome meat or milk. Stasis is regarded as the first condition necessary for the development of toxæmia. He believes that the French have exaggerated the etiological rôle of auto-intoxication, and points out that we lack efficient means of detecting the condition when it is present, and believes that to base a conclusion on the presence of ethereal sulphates is still somewhat premature. In the discussion, Brieger, of Berlin, said that auto-intoxication is supported by the discovery of poison in the urine and in the sweat. He believes that normal urinary toxicity has not been sufficiently established. The potassic salts, which Bouchard employed as a urotoxic coefficient, Brieger considers unsatisfactory. He says that such salts are inoffensive in man, and, therefore, must be displaced as a guide in estimating the toxicity of the urine. The toxicity of the sweat is variable and cannot be admitted as a certainty save when bacterial contamination has been avoided. He also says that there are no certain data on the toxicity of blood-serum. On the whole, these views receive the support of Ewald and Albu. Therapeutically, the purge is considered to be the most important means of relieving intestinal toxæmia, and calomel the favorite drug. Rosenheim, of Berlin, thinks that the employment of intestinal antiseptics must not be completely rejected. Strauss, of Berlin, thinks, in order of their utility, the follow-

<sup>1</sup> International Medical Magazine, Nov., 1898.

<sup>2</sup> Therap. Monatschrift, 1898, No. 11.

<sup>3</sup> Journ. des Prac., 1898, No. 47.

<sup>4</sup> Bulletin Médical, 1898, No. 41.

ing intestinal antiseptics should be employed: Chinsol, thymol, actol, bismuth, betanaphthol, salicylate of bismuth, resorcin, chloral, benzonaphthol, and the soluble silver of Cr  de. Quinke and Boas strongly recommend yeast in chronic constipation.

Intestinal intoxication, it would appear, may develop from the combined action of the colon bacillus with a pyogenic organism when the former alone is harmless. According to the experiments of Malta Cocoin,<sup>1</sup> we must conclude that the whole subject of intestinal intoxication is still, as held by Albu, something of a vague hypothesis, and now that Bouchard's conclusions have been superseded, there remain no practical methods of determining precisely the extent of the tox  mia. The tendency to regard the ethereal sulphates as furnishing a guide to the extent of putrefaction at present holds professional attention, but to ascertain the relative percentage of these is a procedure that demands not only time, but the service of a trained expert. It is, therefore, highly probable that for the present we shall have to continue to depend upon clinical observations and the benefit that follows the purge as the most practicable means of forming our deductions as to the intestinal tox  mia. While antiseptics are not competent to render the intestinal contents sterile, there is much evidence to show that there is a diminution of the putrefactive processes under the influence of these drugs, as held by A. Jacobi.<sup>2</sup>

**Intestinal Tuberculosis.** The source of infection of the intestinal canal is, according to Senn,<sup>3</sup> the ingestion of infected food, or the swallowing of tubercular sputum in victims of pulmonary tuberculosis. The experiments of Gerlach Zurn and Kleb, demonstrating the danger of giving milk from tubercular cows, are cited. By these experiments it was found that the disease commenced in the form of intestinal catarrh, and extended from the mesenteric glands. A form of non-stenotic hypertrophy and tuberculosis of the colon is described by H. Claude.<sup>4</sup> The walls of the gut were much hypertrophied, although the lumen of the intestine was not lessened; the mucosa had largely disappeared through ulceration. Intestinal tuberculosis is seen most frequently in young adults. Reinfection through the mesenteric glands, later in life, is more to be apprehended than the primary lesions. Symptoms of the latter may escape attention. An  mia of the pernicious type or enteric catarrh, with profuse diarrhoea, progressive emaciation, moderate rise of temperature, enlarged mesenteric glands, and the appearance of blood and mucus in the stools, are to be regarded as indicative. In suspected cases bacilli should be searched for in the stools.

<sup>1</sup> *La Riforma Medica*, A xiv., vol. iii., No. 8, p. 96.

<sup>2</sup> *Transactions of Medical Society of State of New York*, 1899.

<sup>3</sup> *Journal of American Medical Association*, January 4, 1898.

<sup>4</sup> *Bulletin M  dical*, December 7, 1898.



**Ankylostoma Duodenale.** From clinical and anatomical study, Leichtenstern<sup>1</sup> believes that ankylostomiasis may be divided into the three stages: First, an incubation period, lasting from four to five weeks, and not indicated by morbid phenomena; second, an acute anæmia, brought about by the extraction of blood, in which the young ankylostoma are produced and find a new place of abode. Clinically, there is no blood found in the defecation. Third, the chronic stage, in which the anæmia is either stationary or progressive, due both to the loss of blood and to the toxic substances developed by the parasites. These views are practically those entertained by Zinn and Jacoby.<sup>2</sup> The latter observers think that the parasite, having found lodgement in a community, is likely to extend to all those coming in contact with the infected. They found the egg of the ankylostoma in individuals who were apparently in good health, but were, nevertheless, capable of transmitting the infection.

**Digestion and Absorption Through the Intestine.** In a valuable study of this subject, Aldor<sup>3</sup> shows that natural albumins are better absorbed by the rectum than those that are partially peptonized, and are also less irritating. Milk seems to be the best form of rectal alimentation, although the cause of the coagulation of the milk he has not ascertained. It apparently depends upon the action of colon bacteria, but is not overcome by previously washing the bowels; the milk becomes acid during the coagulation. When the bowel is irrigated with a large amount of water, at least an hour before the enema, a quart of milk may be introduced at a time without discomfort to, or expulsion by, the patient. The carbohydrates he found most quickly absorbed, the albumins next, and lastly the fats. He failed to find evidence of albumin or sugar in the urine after the use of these substances per rectum.

## THE LIVER.

**The Functions of the Liver.** The secretion of bile under various influences has been studied by Rutherford and Grainger Stewart.<sup>4</sup> In a case in which cholostomy had been performed, the secretion was found to be remarkably regular from day to day; it increased after breakfast and more particularly after dinner, the rise showing itself an hour after the ingestion of food, and continuing thereafter for several hours. Full doses of morphine did not affect the secretion, nor did moderate amounts of alcohol. Sodium salicylate increased the amount of fluid and the salts of the bile, while the effect of salicin was uncertain. From experi-

<sup>1</sup> Wien. klin. Rundschau, 1898, No. 27.

<sup>2</sup> Berliner klin. Wochenschrift, October 28, 1898.

<sup>3</sup> Centralbl. für innere Med., February, 1898; Arch. für Verdauung Krank., 1898, Band 4.

<sup>4</sup> British Medical Journal, September 17, 1898.

ments on animals, William Bain<sup>1</sup> concluded that the biliary secretion was not influenced by vagus stimulation. Little effect was produced by the injection of normal saline solution in the jugulars, but the injection of Harrogate water and a solution of Plattner's crystals accelerated the flow of bile.

Interesting studies on the influence of bile upon the metabolism have been reported by Pfaff and Balch,<sup>2</sup> and by E. P. Joslin,<sup>3</sup> who quotes the results of Von Noorden's work in the same line. The bile and bile salts have been shown to have a marked cholagogue action. The amount of urine was found by Joslin to be increased over 50 per cent. in the bile-taking period, although he would not regard bile as a diuretic *per se*. The percentage of fat lost in the stools was much diminished during the bile-taking period, and there was also a marked increase in the amount of nitrogen assimilated by the body. The quantity of bile solids secreted during the period of bile-taking was 37 per cent. greater than before or after. The experiments also showed that constipation was relieved, and that urea and nitrogen, as would be supposed, were secreted in greater amount while bile was being taken.

**Hepatic Insufficiency.** Kowalski<sup>4</sup> holds that the external application of warm water favors the secretion of bile, and the application of cold water following warm water favors the expulsion of bile previously secreted.

Depreciation of the blood, according to Gilbert and Castaigne,<sup>5</sup> induces hepatic insufficiency—a conclusion reached through clinical study. The effect upon the liver of interruption of its blood-supply has been studied by Doyen and Dufourt,<sup>6</sup> who found that ordinarily ligation of the hepatic artery causes the death of the animal. The occasional survival of the animal is attributed to establishment of collateral circulation. The output of urea and total proteids was considerably lowered, although it did not perceptibly vary when the portal vein was tied, although under the latter experiment the animals quickly succumb.

As an index to hepatic insufficiency, Roger and Garnier<sup>7</sup> suggest the rectal injection of sulphuretted hydrogen gas. It is found that a certain amount of this gas introduced in the peripheral veins of animals is required before its odor is obvious in the animal's breath, and five times this amount must be injected into the portal veins to produce the same phenomenon. If the liver is injured by the action of poisons or other

<sup>1</sup> British Medical Journal, September 17, 1898.

<sup>2</sup> Journal of Experimental Medicine, 1897, No. 1.

<sup>3</sup> Boston Journal of Medical Sciences, May, 1899.

<sup>4</sup> Przegląd Lekarski, R. 37, 1898, No. 49.

<sup>5</sup> Bulletin Médical, April, 19, 1899.

<sup>6</sup> Ibid., 1898, No. 29.

<sup>7</sup> Ibid., 1898, No. 53.

means, a much less quantity of gas produces the characteristic odor in the exhalations. It is possible to utilize this gas in diagnosis by resorting to rectal injections. The method may be as valuable in hepatic inactivity as the methylene-blue test is in renal insufficiency. Gilbert and Weil<sup>1</sup> believe that they have shown that indicanuria is a symptom of hepatic insufficiency.

**Protective Influence of the Liver.** There is reason for thinking that the liver exercises a protective influence on the organism in arresting and destroying divers bacteria. Roger<sup>2</sup> thinks that he has shown this in animals; but when there is an association of certain bacteria this peculiar power is diminished. He found that the sterilized culture of bacillus prodigiosus diminishes this action of the liver, and in large doses completely abolishes it. He suggests that this may explain the serious results of mixed infection, and in these cases he demonstrated that small doses of ether had the power of restoring the bactericidal action of the liver and reviving nearly moribund animals. This is evidence in favor of ether in protecting the organism against infectious disease. G. Fütterer<sup>3</sup> recovered the bacillus prodigiosus and *B. pyocyaneus* from the jugular veins of dogs, into the portal veins of which these organisms had been injected. These organisms were discharged through the kidneys and liver, particularly through the latter. Adami<sup>4</sup> reached similar results, which led J. E. Moore<sup>5</sup> to infer that cholecystitis may be induced by infection passing through the blood, and exclusive of entrance by the ductus choledochus. The effect of starvation upon the action of the liver is in doubt. Roger and Garnier believe that inanition diminishes the antitoxic function of the liver; although, so far as infection is concerned, Fütterer found that it was but little influenced by starvation, which receives support in the experiments of Meltzer and Norris,<sup>6</sup> who found that the bactericidal action of the blood is little affected by starvation in animals. That the liver neutralizes or destroys toxic substances going to it in the portal blood, thus protecting the systemic circulation, has been demonstrated by Schriff, Ibeger, Lussona Jacques, Baltus, and Roger. On the other hand, Stick accords to the intestine this power, rather than to the liver, and finds support in the investigation of Queirolo, Charrin, and Cassin. Tedeschi<sup>7</sup> has attempted to settle which of the two organs is most responsible for this protective influence, and concludes that while the liver has a certain antitoxic action, for the most part

<sup>1</sup> Bulletin Médical, 1898, No. 26.

<sup>2</sup> Ibid., 1898, No. 85.

<sup>3</sup> Berliner klin. Wochenschrift, January, 16, 1899.

<sup>4</sup> British Medical Journal, October, 27, 1898.

<sup>5</sup> New York Medical Journal, March, 1899.

<sup>6</sup> Journal of Experimental Medicine, vol. iv, 1899.

<sup>7</sup> Bulletin Médical, 1899, No. 6; from Giornale Inter. delle Scienze Mediche, Anno XX.

this is exercised by the epithelium of the intestine or is due to the abundance of the microbic flora.

**Hepatic Blood-supply.** Borrmann<sup>1</sup> adds his pathological studies to the question of portal obstruction. When, as the result of thrombosis, there is complete and sudden obstruction of the portal vein death ensues; but when there is passage of a portion of the blood, life may be continued indefinitely. Osler long ago reported a case that survived, through the establishment of inosculation, under complete closure of the portal vein by a thrombosis. Borrmann found that the effect of portal thrombosis upon the liver is less important than is supposed. While there results a moderate interstitial sclerosis and atrophy, the liver is but moderately changed, although the repeated occurrence of ascites after puncture is striking.

The enlargement of the liver occurring in lobar pneumonia is believed by Gilbert and Grenet<sup>2</sup> to depend in some cases upon congestion of the liver, but for the most part to depend upon lesions of the hepatic parenchyma.

The old bugbear of active congestion of the liver has recently been revived by Bain,<sup>3</sup> who says that it may occur independently of organic disease, and may exist for several weeks or months. The etiology includes the familiar factors of indiscretions at table, gout, gastro-intestinal derangement, and residence in hot climates. The symptoms are those of toxæmia, with tenderness of the liver, high-colored and concentrated urine, and a tendency to sclerotic enlargement. In congestion of the liver that follows thoracic disease, benefit may be derived by manual compression of the organ and other forms of abdominal massage, which methods are highly recommended by Rondot<sup>4</sup> and by Huchard.<sup>5</sup>

**Acute Yellow Atrophy of the Liver.** A case of recovery from apparent acute yellow atrophy of the liver, in which all the criteria of the disease, except the fatal termination, were present, has been reported by D. R. Dobie.<sup>6</sup> As to the etiology of this mysterious affection, Richter<sup>7</sup> reports two observations of the disease occurring simultaneously with the beginning of secondary manifestations of syphilis. He says that it rarely occurs in the relapse of syphilis, and is most unusual in long-standing cases; that it does not depend on mercury is shown from the fact that in one case no specific treatment had been inaugurated.

**Syphilis of the Liver.** Adami<sup>8</sup> concludes that pathologically and anatomically the hepatic lesions found in syphilis are identical in adults

<sup>1</sup> Deutsche Arch. für klin. Med., 1898, Band lix., p. 283.

<sup>2</sup> Bulletin Médical, November 1, 1898.

<sup>3</sup> British Medical Journal, October, 1898.

<sup>4</sup> Gaz. Heb. de Sciences Medicales, 1898, Nos. 48-50.

<sup>5</sup> Bulletin Médical, 1898, No. 58.

<sup>6</sup> British Medical Journal, Nov. 12, 1898.

<sup>7</sup> Cited in Wien. med. Blätter, 1898, No. 21.

<sup>8</sup> New York Medical Journal, April 22, 1899.

and children. Such differences as they present are due to the variations in the reactive power of hepatic parenchyma at different life periods. In both are found large, well-formed gummata, miliary gummata, acute parenchymatous hepatitis, with jaundice and syphilitic cirrhosis. In the adult, owing to the element of time, there may be found obsolescent and obsolete gummata, and certain tumor-like outgrowths apparently resulting from the "slowly progressive centrifugal infection of the liver tissue from an original isolated gummatous focus."

**Cirrhosis of the Liver.** Hayem<sup>1</sup> attempts to show that a relation exists between the hepatic cirrhosis and the gastric mucous membrane. In atrophic cirrhosis of the liver he has found the presence of apepsia and hypopepsia the rule, but in hypertrophic cirrhosis, on the contrary, he found an abundance of acid and a condition corresponding to mucous parenchymatous gastritis—a condition which Hayem has particularly dwelt upon in the past. The atrophic cirrhosis of Laennec, Hayem regards as more rare to-day than it was twenty years ago. He believes that in wines are found substances that are productive of sclerosis. The theory of Lancereaux, propounded some years ago, that cirrhosis depends on the presence of the acid sulphate of potassium in wine, has not been substantiated by other observers. The late experiments of G. Rossi,<sup>2</sup> as well as those of Riche, seem to refute Lancereaux's theory. Klemperer reports a case of cirrhosis of the liver that he had followed for ten years, in which he was able to show a hypertrophic and later an atrophic stage. There was found the characteristic atrophy of the liver post-mortem. On the whole, evidence is accumulating that cirrhosis of the liver is not a unit, but that changes so classified depend on a variety of causes. That infection is an important element in its development is highly probable. Adami<sup>3</sup> found in the cirrhotic liver a great number of bacilli which he believes to be a degenerative form of colon bacillus. He regards the presence of these failing bacilli as indicative of the destructive action of the liver upon micro-organisms; but, at the same time, he believes that such organisms under certain conditions give rise to a parenchymatous degeneration of the liver and the replacement of hepatic cells by fibrosis. Adami quotes Flexner<sup>4</sup> as showing that toxic substances may lead to the development of cirrhosis; also Weaver,<sup>5</sup> that there exist certain bacteria that directly induce hepatic cirrhosis. These contributions seem to show that either bacteria or their toxins are conspicuously at work in the development of certain forms of hepatic

<sup>1</sup> Bulletin Médical, 1898, No. 26.

<sup>2</sup> La Riforma Medica, December, 1898, A. 14, No. 295.

<sup>3</sup> New York Medical Journal, April 22, 1898.

<sup>4</sup> Transactions of Pathological Society of Philadelphia, 1896.

<sup>5</sup> Philadelphia Medical Journal, February 4, 1899.

cirrhosis ; although it should be stated that some observers, for instance E. R. Larned,<sup>1</sup> have failed to find the bacteria as described by Adami. The fact that in hypertrophic biliary cirrhosis the lymphatic glands about the liver are found to have undergone enlargement, sometimes with softening at the centre, as reported by Gilbert and Fournier, and to which attention has been called by Jaccoud, Popoff, of St. Petersburg, and many others, seems to favor the theory of infection. While the weight of evidence points to infection as the probable cause of certain forms of hypertrophic cirrhosis, the explanation is more difficult so far as the atrophic form of the disease, without icterus, is concerned, as pointed out by Rosenstein,<sup>3</sup> of Leyden. Most English observers, including Drummond, James, and Ewart, hold to the great importance of alcohol as an etiologic factor.

The term hypertrophic cirrhosis has led to much confusion, and undoubtedly several different types of the disease have been described under this name. To begin with, we must acknowledge, with H. Heinecke, that there is a secondary as well as a primary form of hypertrophic cirrhosis. The secondary form results from obstruction, no matter how induced, from calculus, inflammatory adhesions, or pressure. Here the liver is large, and the distended bile passages show various grades of angiocholitis, although, according to Kirikow,<sup>4</sup> in some cases no angiocholitis is found post-mortem. The primary form Heinecke identifies with the so-called hypertrophic cirrhosis of Hanot. To the last-named affection Dr. Osler<sup>5</sup> has repeatedly called attention. He says : "The course is slow, lasting from eight to fifteen years ; it shows slight jaundice in the absence of ascites and all signs of portal obstruction. There are attacks of local pain in the liver, often simulating gallstone, and attacks of fever, sometimes markedly remittent, in other cases of high and continuous type. The termination is sometimes that of icterus gravis, with fever, coma, delirium, or convulsions, and other evidences of acute toxæmia." This description closely parallels that of acute yellow atrophy of the liver, but in Hanot's disease the liver is found to be large and, it may be added, the course is extremely slow. Gilbert,<sup>6</sup> who was a pupil of Hanot, and J. Castaigne hold that the essential feature of Hanot's cirrhosis is chronic icterus, with considerable enlargement of the liver and spleen. Kirikow thinks that too much importance is attached to the hypertrophy of the liver, and shows that the splenic

<sup>1</sup> Philadelphia Medical Journal, December 3, 1898.

<sup>2</sup> Bulletin Médical, 1898, No. 44.

<sup>3</sup> British Medical Journal, October 1, 1898.

<sup>4</sup> Ziegler's Beiträge zur Pathol. Anat., Band xxii., Heft 2.

<sup>5</sup> Transactions of Association of American Physicians, 1899 ; British Medical Journal, October 1, 1898.

<sup>6</sup> Bulletin Médical, 1899, No. 40.

enlargement, which is always present in Hanot's cirrhosis, deserves more attention. The disease cannot be explained on mechanical grounds, and it is probably to be regarded as an infection. Gilbert reports certain subclasses of Hanot's cirrhosis, in some of which he speaks of the occurrence of ascites, and also believes that the hepatic cells react to the stimulus, and that recovery may ultimately take place. Boix<sup>1</sup> says that the disease sometimes occurs as a family affection. Like Osler, he dwells upon the pigmentation as a marked characteristic of the affection. In the family of one of his patients the pigmentation was seen in the children as well as in the collateral branches. He agrees with Hanot and Reiner in attributing the affection to a specific and not a general hepatic infection.

Hæmatemesis from cirrhosis of the liver sometimes occurs when the hepatic change cannot be discovered clinically. Marmasse<sup>2</sup> reports such a case in which cirrhosis afterward developed, and in which varicosities were discovered post-mortem.

Marchiafava<sup>3</sup> refers to the frequency of œsophageal hemorrhage and the relative frequency of gastrorrhagia, which accords with the experience of most observers. Not only hemorrhoidal bleeding, but menorrhagia also, according to Courtois-Suffit,<sup>4</sup> may be expected with cirrhosis; but, as Dalche<sup>5</sup> states, this condition is found in biliary lithiasis and other hepatic states. The relief of ascites due to portal obstruction in cirrhosis of the liver has not only been suggested, but actually has been carried out through the establishment of collateral anastomosis by surgical means, as reported by Morrison,<sup>6</sup> and also by S. Talma.<sup>7</sup> The remarkable statement is made by Reickel<sup>8</sup> that he has cured a case of hepatic cirrhosis through the use of inunctions of mercury, although no evidence of syphilis was discoverable.

**Biliary Lithiasis, Cholecystitis, and Angiocholitis.** It is a well-known fact that biliary lithiasis is rarely found in young children, but that it does occur is shown by G. F. Still.<sup>9</sup> He reports three cases, one of which died of tubercular meningitis. The opinion is growing that biliary calculus is merely the result of infection of the bile passages; but the infrequency of the affection in young children and its relative great frequency in women would seem to show that there are other factors than infection at work. This subject has received extensive consideration by Stanislaus Pechkranc,<sup>10</sup> whose article has been translated by Francis E. Fronczak,<sup>11</sup> who concludes that the dyscrasic theory, once universally held

<sup>1</sup> Bulletin Médical, 1898, No. 22.

<sup>2</sup> Gaz. Heb. de Med. et de Chir., January 26, 1899.

<sup>3</sup> Bulletin Médical, 1899, No. 16.

<sup>4</sup> Ibid., 1898, No. 92.

<sup>5</sup> Ibid.

<sup>6</sup> London Lancet, May 27, 1899.

<sup>7</sup> Berliner klin. Wochenschrift. Cited in Philadelphia Medical Journal, November 19, 1898.

<sup>8</sup> Wien. med. Blätter, 1898, No. 48.

<sup>9</sup> British Medical Journal, April 18, 1899.

<sup>10</sup> Medycyna, tom. xxvii., Nos. 6 and 7.

<sup>11</sup> Buffalo Medical Journal, June, 1899.

and now maintained by many clinicians, is merely a contributing factor, and that the essential cause is a cholecystitis. It is therefore impossible to separate the subjects of cholelithiasis and cholecystitis, to which should be added angiocholitis. Naunyn,<sup>1</sup> of Strassbourg, who has enlightened us so much on this subject, says that in cholelithiasis the tumor of the gall-bladder and the hepatic colic are due to cholecystitis. The icterus results from cholecystitis and angiocholitis, except when a stone lies in the ductus choledochus, preventing the flow of bile. He points out that when no gallstone is present, attacks identical with gallstone colic are witnessed and are dependent upon cholecystitis. He shows that many of the sequelæ of gallstone, such as abscess of the liver and the migration of gallstones into the intestine and other hollow viscera, are the results of cholecystitis, or angiocholitis accompanying it. The discharge of the gallstone from the bladder into the cystic duct is the result of serous transudation into the gall-bladder, due to inflammation of its mucosa, or spasm of the muscular coats of the gall-bladder excited by the inflammatory process. Cholecystitis and angiocholitis are infectious from the beginning. In health the bile is sterile, and after infection it may, in long-standing cases, again become sterile. Mosse<sup>2</sup> says that bile retards fermentative changes in sterile mixtures, but if putrefactive bacteria have developed the addition of bile increases the putrefactive change. It is during the infectious period, as shown by Naunyn and the French observers, that calculi are formed. While the symptoms may be relieved with the passage of a gallstone and the free drainage of the biliary passages, the infection for the time continues, perhaps remains latent, but sooner or later it may become active, with or without the development of other calculi. The accompanying jaundice is not necessarily due to obstruction by calculus, but may follow the swelling of the biliary passages. When it results from a calculus it may be from a stone lodged in the ductus choledochus. A calculus thus retained may produce an intermittent jaundice, through the ball-valve action described by Fenger in 1896. Not infrequently the concretion may be engaged in the cystic near the hepatic duct, and by pressure upon the latter may produce jaundice; or a large stone may remain in the common bile duct without any jaundice appearing. These general conclusions are partly based on the investigations of Naunyn, strengthened by the remarkable work of Mignot, Gilbert,<sup>3</sup> and Fournier.<sup>4</sup> These French observers have developed cholelithiasis in animals experimentally, and have found that in order to produce a calculus it is necessary to have infection of the

<sup>1</sup> Münch. med. Wochenschrift, October, 1898, No. 40.

<sup>2</sup> Zeit. für klin. Med., Band xxxvi., p. 537.

<sup>3</sup> Arch. Generale de Médecine, August and September, 1898.

<sup>4</sup> La Presse Médicale, 1898.



biliary passages. This conclusion is of the utmost importance, and is meeting with general confirmation. M. W. Richardson,<sup>1</sup> of Boston, has repeated some of these experiments with similar results. Mignet found that foreign bodies in the gall-bladder, if sterile, produced no unfavorable effect. The organism most commonly found inhabiting the gall-bladder is the colon bacillus, but its life-history in the gall-bladder is believed to be comparatively short. Its existence here may, however, be considerably prolonged under favorable conditions. Many other forms of bacteria have been found, including the proteus vulgaris,<sup>2</sup> tubercle bacillus,<sup>3</sup> staphylococcus, streptococcus, bacillus subtilis, and, very commonly, the typhoid bacillus. Many instances of the last-named infection of the gall-bladder are reported, among which may be mentioned those of Emil Ryska,<sup>4</sup> M. W. Richardson,<sup>5</sup> J. M. Da Costa,<sup>6</sup> and Camac.<sup>7</sup> The latter reports forty cases of typhoid fever which on bacteriological examination revealed the presence of typhoid bacillus in thirty-four. The various facts connected with the experimental work of the French observers are of great interest, and should be read in detail. That their conclusions, although somewhat revolutionary, are destined to stand, seems probable. W. Hunter<sup>8</sup> reviews the English sentiment on the subject. While conceding much to the rôle of infection in the development of biliary calculi, he still holds to the belief that diet, sedentary habits, tight lacing, etc., contribute to the development of biliary calculi. Undoubtedly there are contributing factors that lower the immunity of the biliary passages and thus make possible not only the development of gallstone, but the appearance of the still more serious events of cholecystitis, such as empyema of the gall-bladder and suppurative angiocholitis. In this connection may be quoted the interesting observation of Rodman,<sup>9</sup> in a discussion on cholelithiasis, in which he states that out of 166 cases on which he operated only one was a full-blooded negro—the author practising in a region in which there is a large colored population. Attacks that were apparently hepatic colic are described by William C. Krauss<sup>10</sup> in a patient who, after death, was found to have suffered from posterior spinal sclerosis, and in whom the gall-bladder and liver were found normal. Jeanselme and Rabe<sup>11</sup> report a remarkable case of hemihyperæsthesia following an attack of hepatic

<sup>1</sup> Journal of Boston Society of Medical Sciences, January, 1899.

<sup>2</sup> Gouget. Arch. de Med. Experi., 1897, No. 4.

<sup>3</sup> Morley Fletcher. British Medical Journal, April 21, 1899.

<sup>4</sup> Münch. med. Wochenschrift, 1899, No. 23.

<sup>5</sup> American Journal of the Medical Sciences, June, 1898.

<sup>6</sup> Ibid.

<sup>7</sup> Ibid., July, 1898.

<sup>8</sup> British Medical Journal, October, 1897.

<sup>9</sup> Surgical Section of American Medical Association, June 5, 1899.

<sup>10</sup> Journal of Nervous and Mental Disease, February, 1898.

<sup>11</sup> Bulletin Médical, 1898, No. 57.

colic. This was undoubtedly from hysteria, which is a not infrequent complication of cholelithiasis.

**TREATMENT.** In the treatment of angiocholitis, Willoughby<sup>1</sup> speaks of the use of toluylendiamine—one grain twice daily. Montier<sup>2</sup> reports prompt relief of biliary colic by the application of the high-frequency electrical current. Gautier,<sup>3</sup> of Geneva, recommends ox-gall for the prevention of the recurrence of calculi. At a meeting of the Alumni of the City Hospital (New York)<sup>4</sup> the advisability of using olive oil was still advocated. However valuable these means may be the Carlsbad treatment meets with general approval. Hermann<sup>5</sup> shows the value of the treatment not only in curing cases, but in preventing the recurrence of calculous diseases after the removal of stone by surgical intervention, thus avoiding an occasional embarrassment to the surgeon.

**Jaundice.** A mild form of icterus without the appearance of bile pigment in the urine has been studied by Hayem,<sup>6</sup> who has recently reported four additional cases. All these patients suffered from dyspepsia, he believes, through an associated parenchymatous gastritis with secondary involvement of the duodenum and biliary passages. The pathology of the matter is not clear. It is the rule to have bile pigment appear in the urine in secondary infectious icterus, and this usually depends upon catarrhal angiocholitis. Gilbert and Grenet<sup>7</sup> have shown that when jaundice complicates lobar pneumonia the attending cholangitis is from the invasion of the bile passages by the bacterium coli communis and not upon the presence of the pneumococcus. It is probable that the jaundice is not merely an accident, but that the invasion of the biliary apparatus is invited by the depression produced by the toxæmia of pneumonia. Castaigne holds that alimentary glycosuria should always be sought for in cases of benign infectious icterus. When the result is negative, it may be considered as evidence that the disease will reach an early and favorable termination, but a positive glycosuria points to a more serious infection.

**Abscess of the Liver.** The belief that abscess of the liver is almost invariably secondary to dysentery or other suppurative processes in the intestine receives further support in the studies of Boinet,<sup>8</sup> who says that a dysentery, often too light to attract the patient's attention, will be found to have preceded a hepatic abscess, and points to the fact that cicatrices are found in the intestine of persons dying with abscess of the liver, but who had denied all history of dysentery. Boinet believes

<sup>1</sup> Therapist, March 15, 1899. Quoted in Philadelphia Medical Journal, April 29, 1899.

<sup>2</sup> La Presse Médicale, December 24, 1898.

<sup>3</sup> Bulletin Médical, 1898, No. 36.

<sup>4</sup> New York Medical Journal, June 24, 1899.

<sup>5</sup> Medycyna, February, 1898.

<sup>6</sup> Bulletin Médical, March 25, 1899.

<sup>7</sup> Ibid., November 1, 1898.

<sup>8</sup> Ibid., May 1, 1898.

that the abscess may occur as late as three years subsequent to the dysentery. That an abscess may exceptionally result from other sources of infection is shown by B. Leick,<sup>1</sup> who has collected eighteen reported cases, beside contributing one of his own, of hepatic abscesses produced through invasion of the bile-passages by lumbricoid worms. Abscess of the liver during its early stages is often overlooked and sometimes mistaken for malaria, for the reason that the patients suffer from intermittent fever and enlargement of the liver. In speaking of this, E. C. Field<sup>2</sup> points out that such fevers resist quinine in full doses, and that though the liver is enlarged in malaria, the spleen is still more so, which is the reverse of what occurs in hepatic abscess. The rise of fever in abscess is almost invariably late in the day, whereas in malaria it frequently appears in the morning. Beside this it must be remembered that dysentery is an almost invariable antecedent of abscess of the liver, and, finally, the examination of the blood for the plasmodium should determine the question. The recurrence of hepatic abscess after apparent recovery is said by Marshall<sup>3</sup> to be much more probable if the patient remains in, or too early returns to, a tropical climate. He thinks this is particularly true when the abscess is dependent upon the presence of the amoeba coli, owing to the more serious and wide-spread damage to the liver tissue associated with the presence of that organism. Even when there is in the liver a large cavity, surrounded by a firm fibrinous capsule, such as often results in recovery from abscess, a year or more should elapse before the patient should incur the risk of returning to a tropical climate.

## THE SPLEEN.

**Method of Examining.** Some new views on the method of examining the spleen are expressed by Dr. James Cantlie.<sup>4</sup> He holds that the spleen cannot be successfully made out either by palpation or percussion when the patient lies on the back, because the organ is situated too far posteriorly in the hollow of the ribs, lying in the angle of the ninth, tenth, and eleventh ribs, the long axis parallel with the tenth—the so-called “splenic rib.” He says the outer end of the spleen does not come further forward than the posterior axillary line. He thinks when the patient lies on the right side the spleen moves forward with the body, thus rendering the percussion fallacious; and when the patient is lying prone on the abdomen the spleen moves forward and cannot be made out by percussion unless held in position

<sup>1</sup> Deutsche med. Wochenschrift, 1898, No. 20.

<sup>2</sup> Georgia Medical and Surgical Journal, December, 1898.

<sup>3</sup> British Medical Journal, June 10, 1898.

<sup>4</sup> New York Medical Journal, June 10, 1899.

by the adhesions of an old perisplenitis. He says that the only proper position for mapping out the spleen is when the patient is standing erect. All of this is interesting, and the difficulties spoken of are real when the spleen is naturally small. The difficulties, however, disappear when the spleen is large, under which circumstances it can be made out by proper percussion, not to mention palpation, no matter what posture is assumed by the patient. Nevertheless, when splenic dulness cannot be made out, it is wise to follow the suggestions of Cantlie. We must remember that the spleen is sometimes so small that it escapes discovery by ordinary physical examination, and Hodenpyl<sup>1</sup> reports a case in which the spleen was absent, and in which there occurred a general compensatory hyperplasia through the lymph nodes. In auscultation over the spleen there is sometimes heard a murmur, which Gabbi<sup>2</sup> believes to be extrasplenic in origin. It rarely occurs in the spleen of malaria or in leukæmia or pseudoleukæmia, but it is found in connection with perisplenitis, with increase and thickening of the connective tissues where the vessels enter the hilum of the organ.

**Function of the Spleen.** A curious side-light is thrown upon the action of the spleen by the experiments of Blumenreich and Jacoby,<sup>3</sup> who found that guinea-pigs from which the spleen had been removed resisted far better than other animals the injections of various pathogenic bacteria and other toxins. Among others they experimented with injections of diphtheritic toxin. They account for this singular result by marked hyperleucocytosis which follows splenectomy. The increase of leucocytes was almost limited to the lymphocytes. When we remember Ehrlich's view that leucocytosis largely originates in the spleen this result becomes still more curious.

**Chronic Enlargement of the Spleen.** There are several forms of chronic primitive enlargement of the spleen. In discussing this question Prof. Osler<sup>4</sup> first excludes the enlarged spleen of leukæmia, malaria, hepatic cirrhosis, chronic congestion, and rickets. The remaining primitive enlargements of the spleen he divides into two groups: In the first the spleen is found to be cirrhotic, and the enlargement occurs without other causes or symptoms save those due to mechanical pressure. Of this group he reports four cases, all women, seen in recent years. In two the organ was freely movable, and was removed in each case by Dr. Halsted, and both recovered. In the third case the spleen became partly sphacelated as the result of twisting of its ligament, and was enormously enlarged and adherent. It was incised by Halsted, and a large quantity of necrotic spleen tissue removed, after which the patient made a quick recovery. In the second division Osler places the enlargement of the

<sup>1</sup> Medical Record, 1893, vol. iv., No. 29.

<sup>2</sup> La Clinica Med. Ital., 1898, 7.

<sup>3</sup> Bulletin Médical, 1899, No. 27.

<sup>4</sup> Edinburgh Medical Journal, May 18, 1899.

spleen with anæmia. These cases have been described by Griessenger as "anæmia splenica," by H. C. Wood as splenic pseudoleukæmia, and it is sometimes called the splenic form of Hodgkin's disease. Osler prefers the name splenic anæmia, and restricts the use of the term to cases in which there is progressive anæmia in connection with primitive splenomegaly. The relation of the large spleen to the anæmia is not yet determined. Of this affection Osler has seen four cases during the present year. The characteristics of the disease are the chronic course, running from three to fourteen years, chlorotic features of the blood, and particularly bronzing of the skin, not depending upon jaundice, and finally hemorrhages. These may be either toxic, as in leukæmia, or mechanical, resulting directly from the condition of the enlarged spleen, in which the hemorrhage would be expected from the stomach and bowels. Such bleeding may be profuse and recur for years, and in the intervals the patient may largely regain health and strength. Osler regards the hemorrhage as entirely due to mechanical causes. The difficulty of classification of these cases of enlargement of the spleen because of our ignorance as to their etiology and of their relation to one another has long been felt. Osler says he has found a practically normal blood-count in primitive splenomegaly, and in cases extending over many years he has found merely an anæmia of the chlorotic type. In other cases the blood at one time showed a leucocytosis resembling leukæmia, and at another time that of simple anæmia. Similar observations have been made by Stengel.<sup>1</sup> The above described cases Osler would distinguish from Banti's disease.

**Banti's Disease.** The primitive enlargement of the spleen followed by cirrhosis of the liver bears this name, because first described by Banti, of Florence, in 1894. In the recent reviews of Banti's<sup>2</sup> work the disease is divided into three stages: The first is characterized by severe secondary anæmia, the red cells showing great loss in number, by the formation of poikilocytes and microcytes, and by great diminution in the hæmoglobin percentage. There is no leucocytosis, nor is there a disproportion between the different white cells. There develops a large spleen, similar to that of leukæmia; the appearance of a splenic tumor is the first apparent symptom. The organ is large, smooth, rounded, and generally painless; the temperature is usually normal; there are occasional attacks of fever, sometimes accompanied by chills. The first stage is a prolonged one, usually reaching from three to five years, and sometimes as long as from ten to fifteen years. The second, sometimes called the transitional stage, lasts only a few months. During this time

<sup>1</sup> PROGRESSIVE MEDICINE, June, 1899, p. 288.

<sup>2</sup> Münch. med. Wochenschrift, 1898, No. 48; Journal of American Medical Association, September 17, 1898.

the urine is diminished in quantity and has a large increase of coloring matter. There usually appear mild jaundice and digestive disturbances. The third stage, or the stage of ascites, develops slowly and painlessly. The liver now diminishes in size and the jaundice increases. The general symptoms, including marked prostration, increase, anæmia becomes worse, and death usually results in from three to seven months.

Post-mortem the spleen is found to be large, with a thickened capsule, without adhesions. There is an increase in the splenic reticulum, and the cut surface is deep-red, marked with whitish lines. There occur many round, whitish, hyalin-like nodules corresponding with the Malpighian bodies. The liver has the appearance of that seen in Laennec cirrhosis, but it never reaches the severity of the more advanced cases of that disease. This change in the liver is seen in the third stage. So far no opportunity has occurred for examining the liver post-mortem during the first state, but in certain instances in which splenectomy has been practised the liver presented a normal appearance. The bone-marrow was fetal in appearance, and the bacterial examination was negative. The differentiation from anæmia splenica is based on the presence of hepatic cirrhosis and the absence of hypertrophy of the lymph nodes characteristic of that disease. Banti believes that the disease depends upon primary spleen disease which invades the liver through the portal vessels, and ultimately leads to a chronic intoxication, from which arises the anæmia and the other general symptoms. He recommends the removal of the spleen during the first or second stage, and from experience believes that this will lead to cure. Some improvement is seen by the use of arsenic, but it does not cure the disease.

### PERITONEUM.

**Chronic Indurative Peritonitis.** This rather rare but very interesting disease has been reviewed by Nothnagel.<sup>1</sup> The affection may be due to previous acute peritonitis, or not infrequently is chronic from the beginning. It occasionally appears to depend upon syphilis. The remarkable feature of the disease is the absence of distinctive symptoms of any kind, although certain definite events result from adhesions or traction upon the abdominal viscera, such, for instance, as intestinal obstruction or occlusion of the biliary ducts. In the development of the latter condition an intermittent jaundice may appear. The diagnosis of this form of peritonitis is to be based chiefly upon the history of the case, but is always to be regarded as difficult.

<sup>1</sup> Klin. Therap. Wochenschrift, January 2, 1898.

**Tubercular Peritonitis.** Much has been learned about the morbid anatomy of tubercular peritonitis as a result of the now common treatment by laparotomy; it is sometimes accompanied by ascites, as in the case reported by Merkel.<sup>1</sup> When ascites occurs it may be encysted or free, and it is often impossible to find bacilli present in the fluid. In one of Merkel's cases the bacilli were found in the peritoneal adhesions, but in another case they were altogether absent. Quénu<sup>2</sup> calls attention to the fact that tubercular peritonitis may often be mistaken for other affections. One of his cases was operated on for intestinal occlusion and the other for appendicitis. In the first case he had previously performed a total vaginal hysterectomy for the relief of suppurative salpingitis. In the first case death ultimately resulted from general tuberculosis, and in the second case from meningitis. Nevertheless, the good results following laparotomy, and the number of cases reported cured after the lapse of several years, are sufficient reasons for the continuance of the surgical form of treatment.

**Acute Peritonitis.** An interesting phase in the course of acute peritonitis has been revived by Cathcart,<sup>3</sup> who shows that in peritonitis there is often to be observed an increased peristalsis of the rectum and other parts of the intestine. This is particularly true in pelvic peritonitis, of which he recites two instances. In these there was marked rectal tenesmus, a symptom that results from periprosthetic inflammation or pelvic abscess, and is secondary to appendicitis and other conditions. Grünbaum, Nothnagel, Treves, and Gee have presented clinical observations in support of the view that peritonitis causes an increase of intestinal peristalsis prior to the time when the muscular coat of the bowels is involved. It is, perhaps, improper to adopt this as a universal law in peritonitis. Even though it is true that in the beginning of the attack marked peristalsis may be observed, on the other hand we sometimes find as an early manifestation an almost complete paralysis of the bowel. We must have more proof than clinical observation before we can accept the theory that this always depends upon the escape of the muscular coat of the intestine from involvement. It is quite as rational to believe that the loss of peristaltic power lies in the effect of the peritonitis upon the nerves, this leading to loss of functional power. We sometimes find great excitement and tenesmus of the urinary bladder when the inflammation does not involve the serous coat of that organ, and the same fact probably holds true of the rectum. The relaxation of the sphincter, accompanying the tenesmus that is observed in peritonitis, would also point to influences other than involvement of the muscular coat of the bowel.

<sup>1</sup> Bulletin Médical, 1898, No. 68.

<sup>2</sup> Ibid., 1898, No. 95.

<sup>3</sup> British Medical Journal, March 18, 1899.

**Ascites.** The presence of blood in ascitic fluid is very suggestive of malignancy. It sometimes is secondary to the separation of adhesions, thus leading to hemorrhage or to bleeding secondary to malignant or other ulcerative processes. In malignant disease the staining of the ascitic fluid by the escaping blood is apt to increase, and thus a comparison can be established by means of repeated paracentesis. In a case of hemorrhagic ascites depending upon a sarcoma, reported by Finny,<sup>1</sup> paracentesis was required five times in less than three weeks.

**TREATMENT.** In the treatment of rapidly recurring ascites dependent upon malignant neoplasm, P. Furbinger<sup>2</sup> recommends the introduction of a rubber tube through a metal trochar after puncture, leaving the rubber tube in place when the trochar is removed. The outlet of the tube is closed by a clasp and the tube held in place by a silk thread and plasters. This enables one to empty the peritoneal cavity frequently without recourse to repeated punctures. The danger of infection of the peritoneum by this process is so great that it should be reserved for cases approaching a fatal termination. Mignot<sup>3</sup> recommends for the treatment of ascites the intraperitoneal injection of sterilized oxygen gas. The author reports considerable experience with this method, and concludes that one or two litres of oxygen should be employed for a single injection. The only sequelæ observed were a slight elevation of temperature and moderate abdominal pain, which disappeared in about twenty-four hours. Some remarkable results seem to have been obtained. H. Schlesinger<sup>4</sup> presented before the Medical Club of Vienna a patient suffering from cirrhosis of the liver and ascites. For three months it had been found necessary to tap him weekly. He was then given from 15 to 20 grammes of urea daily. As a result the diuresis was progressively increased, and the circumference of the abdomen after five weeks' treatment was no greater than was usual immediately after tapping. He reported similar results in other cases, and asserts that other diuretics do not have the same happy effect. This method I have tried in one case with entirely negative results, although the patient was apparently one well suited to the method. The apparent cure of ascites by various forms of treatment must for the most part be attributed to the development of inosculation with the systemic veins, thus forming a natural drainage through the bloodvessels. A surgical procedure for the artificial establishment of venous inosculation promises to be of greater value than any of the measures here recited. So far as I know Mignot's results by the injection of oxygen have not been verified by other clinicians.

<sup>1</sup> British Medical Journal, December 10, 1899.

<sup>2</sup> Centralbl. für innere Med., 1899, No. 7.

<sup>3</sup> Thèse de Lyon, 1898.

<sup>4</sup> Bulletin Médical, 1898, No. 5.



**THE PANCREAS.**

**Pancreatic Cyst.** The cases reported during the last year go to verify the views of Senn, that this is generally secondary to hemorrhage, the result of trauma. In a case reported by Cushing,<sup>1</sup> the cyst followed a blow on the abdomen. In this case there also developed a subphrenic abscess that ultimately discharged through a bronchus, and, as a complication, there developed a double parotiditis. This last event has a significant bearing in view of the supposed sympathy that exists between the salivary glands and the pancreas. While a cyst of the pancreas is apt to appear in the umbilical region, it sometimes develops at points much higher in the abdomen. Such a case is reported by Payr.<sup>2</sup> The patient, a lad of nineteen years, received a blow in the epigastrium which was followed by a tumor that appeared above the stomach and beneath the left lobe of the liver. The two layers of the lesser omentum invested the back and the front of the cyst. E. A. Barker<sup>3</sup> reports a case which developed in a boy who was injured in falling, striking upon the left side. About two weeks subsequently there developed a swelling beneath the left costal cartilage. The dulness of the tumor was continuous with that of the spleen. On drainage, the fluid displayed marked amylolytic properties. These, however, are rather unusual points of presentation for a cyst of the pancreas, its most common direction being forward between the colon and stomach.

**Pancreatitis.** A very important and interesting contribution to this subject appears in the thesis of Paul Carnot.<sup>4</sup> His work shows a vast amount of research, together with experimental and clinical evidence. His aim has been to bring together the facts so far ascertained relating to the various forms of pancreatitis, and so far as possible to fill up the gaps of our knowledge on this subject. He began with the analytic study of pancreatic infections and intoxications. He made a long series of experiments in which the pancreas was infected in various ways, sometimes through arteries, sometimes in the parenchyma, and sometimes in the excretory canals of the organ; in addition to this, the resisting power of the pancreas was lowered by the application of various toxins—diastase, phosphorated oil, menthol, alcohol, etc. He concluded, after comparing his various results, that the changes provoked were in proportion to the intensity of the alterations in the tissues rather than to the nature of the agent that excited them. Thus he found that when a very acute infection was established hemorrhagic pancreatitis followed. This sometimes appeared in a few hours, and sometimes was delayed for a few days.

<sup>1</sup> Medical News, May 7, 1898.

<sup>2</sup> Wien. klin. Wochenschrift, 1898, No. 26.

<sup>3</sup> British Medical Journal, March 18, 1899.

<sup>4</sup> Bulletin Médical, December 1, 1898, No. 101.

A less virulent infection provokes a suppurative or gangrenous pancreatitis, while an infection still less active leads to the more or less complete sclerosis of the pancreas. In the second part of this thesis Carnot makes a synthetical study of pancreatitis thus excited, comparing the lesions with those found in man. Hemorrhagic pancreatitis found in man usually follows grave traumatism, such as severe injury of the abdomen; it sometimes results from intoxication, from mercury, or other poisons. It occasionally is found in the course of severe generalized infection. It will thus be seen that in some instances the exciting cause of hemorrhagic pancreatitis is like that which sets up pancreatic cysts; the difference between the two apparently lying in the infectiousness of the inflammatory as compared with the cyst-forming process. Carnot sometimes observed a sanguinous infiltration of the gland, which was red, and in some parts completely black in color. In some instances there was the usual evidence of autodigestion of the pancreas, which converted the gland into a hematic-pultaceous mass, accompanied by the escape of changed blood into the lesser mesenteric cavity. The symptoms accompanying this process are terrible epigastric pain, with a tendency to syncope, mental excitement, chills, palpitation, thready pulse, and coldness of the surface of the body. These symptoms may continue for a few hours, or days, and then disappear; or the patient, as often happens, may die suddenly in collapse. These attacks may recur several times or terminate in sudden death. Occasionally the march of events is slower, and a cyst is likely to develop. Acute non-hemorrhagic pancreatitis is found in the course of a great number of general infections. The lesions are characterized by the intervenous infiltration of leucocytes with epithelial proliferations of the canalicular cells. The symptoms of the affection are somewhat more vague than those attending the hemorrhagic form of the disease, which may develop into a suppurative pancreatitis. The latter form of the disease sometimes occurs in the history of pyæmia, puerperal septicæmia, variola, typhoid fever, and other severe infections. In the substance of the pancreas there develop multiple small abscesses, or a few large ones, or the whole gland may be transformed into a sort of "purulent sponge." These abscesses are apparently consecutive to an infection of arterial origin, but in some instances they appear to result from an infection beginning in the intestine and finding its way up the excretory ducts of the pancreas. The colon bacillus is the chief organism found, although mixed infections are common. The ascending infections are sometimes secondary to intestinal lesions, pancreatic lithiasis, or intestinal parasites.

It will be seen from the foregoing that there is a more intimate relation between the various forms of pancreatic disease than has been supposed. The same cause may in one person produce a hemorrhage

with cyst; in another, hemorrhagic pancreatitis, perhaps ending in gangrene; or, in a third, a slow interstitial inflammation. The suppurative pancreatitis, which like other inflammatory processes depends upon infection, seems to be less related to the other forms of pancreatic disease. The most interesting, as well as the most tragic type of pancreatitis, is the acute hemorrhagic form. The suddenness of the onset, the alarming symptoms, and the too often sudden and unexpected fatal termination surround this disease with particular interest. Not infrequently the cause is attributed to poisoning, and, therefore, the disease is an important one from a medico-legal aspect. Such a case is reported in the *Lancet*, in which chloral and morphine were found in the stomach contents of a patient discovered dead in bed. But for the finding of hemorrhagic extravasation in the head of the pancreas, together with acute pancreatitis, the examiner would have attributed the death to poisoning. I remember an instance of the disease in which death followed five minutes after a hypodermatic injection of morphine. Here the post-mortem revealed small hemorrhages throughout the pancreas and a beginning pancreatitis. Sometimes the symptoms resemble those of atropine poisoning, as reported in the case of Reynolds.<sup>1</sup> The sudden, fatal termination in the disease is difficult to explain, and is usually attributed to shock. A. S. Warthin<sup>2</sup> found an involvement of the pacinian corpuscles in one case, and supposes that this may account for the shock and sudden death. The rapidity of the hemorrhage in some instances is surprising. In a case reported by A. D. Fripp and J. H. Bryant,<sup>3</sup> the patient was seized with intense pain in the umbilical region and went into collapse. Forty-eight hours later laparotomy showed much blood-stained peritoneal fluid. A. S. Warthin holds that the hemorrhage is probably from diapedesis, due to the effects produced upon the vessel walls by the poisonous secretion of the pancreas. In his case degenerative changes in the bloodvessels, especially in the veins and capillaries, and not limited to those of the pancreas, but appearing in various remote parts of the body, were marked.

A valuable series of cases is reported by Newton Pitt and Mr. Jacobson.<sup>4</sup> In one of these cases, that of a woman, aged seventy years, who after a hearty breakfast was seized with intense pain, vomiting, and collapse, there appeared a constant desire to defecate, which was not relieved by enema. This symptom is not peculiar to this case, and instances have been reported in which perforation of the bowel has occurred with discharge of portions of the pancreas per rectum. In the patient above referred to there was marked tympanites, although death

<sup>1</sup> Medical Chronicle, 1898. Cited in Int. Med. Mag., November, 1898.

<sup>2</sup> Philadelphia Monthly Medical Journal, February, 1899.

<sup>3</sup> British Medical Journal, December 17, 1898.

<sup>4</sup> Ibid.

occurred forty-eight hours after the beginning of the attack. Particles of food were brought away with the constipated evacuation from the bowels. At necropsy, beside hemorrhagic pancreatitis, there were found acute peritonitis and fat necrosis of the omentum. The fifth case of Pitt and Jacobson was that of a tavern-keeper, fifty-eight years old, who suffered from severe abdominal pain and vomiting for three months. He had had occasional attacks of gastric pain for some years. There developed a thick pulsating tumor in the upper part of the abdomen; death came from exhaustion, and at the post-mortem there were revealed a peritonitis with extensive fat necrosis and a broken-down necrotic pancreas communicating with a cavity behind the stomach that was filled with a brown pulstaceous fluid. Langdon, in discussing this series of cases, gives the history of one case very similar to the last described, in which diarrhoea and emaciation were important symptoms in addition to the vomiting, pain, and tympanites. Paracentesis was performed, and eleven pints of blood-stained ascitic fluid were withdrawn. Two weeks later laparotomy was performed, when a tumor was found behind the transverse colon, and seven pints of blood-stained fluid aspirated. This blood-sac was connected with the pancreas; the patient, after making a good recovery, died two years later of sudden hemorrhage of the bowels. At post-mortem the pancreas was nearly obliterated. The hemorrhage was attributed to cicatricial obstruction of the portal veins.

Dr. Bryant and Mr. Bowlby stated that some of these cases might result from embolism of the pancreatic arteries, although no instance of such arterial obstruction has been reported. Such obstruction might undoubtedly lead to a gangrenous pancreatitis, which is but another phase of the acute hemorrhagic form. Two cases of this condition are reported by Herman A. Brennecke,<sup>1</sup> in both of which laparotomy and drainage were practised. In one the death of the patient followed almost immediately, while the other survived the operation twenty-five days, and then died from a slow form of sepsis. There was an alcoholic history in both cases, and in one a syphilitic history. One had diarrhoea and involuntary evacuations and the other constipation. The sudden onset of severe pain, obstruction, and vomiting were conspicuous, as they are in all of these cases.

**Fat Necrosis.** Fat necrosis is an almost invariable accompaniment of acute pancreatitis. It occurs particularly in the tissues about the pancreas, but is usually disseminated more or less throughout the peritoneal fat and sometimes in that of the abdominal wall and even more distant portions of the body. Warthin found evidences of necrotic changes in the blood and lymph channels in widely separated regions.

<sup>1</sup> Journal of American Medical Association, June 4, 1898.

Many experiments have been made to elucidate the problem connected with this remarkable process, among which those of H. U. Williams and Flexner, in this country, and those of Minkowski and Chiari abroad, are conspicuous. Some recent studies have been made by A. Katz and F. Winkler.<sup>1</sup> They agree with the conclusions reached by previous observers, that the injection of bacteria into the tissues of the pancreas rarely leads to the production of fat necrosis, or at any rate that the process occurs in only a minor degree as compared with abscess, sclerosis, or hemorrhage. They also, like other observers, find that if the body of the pancreas is ligated and incised, or is torn, fat necrosis almost uniformly develops. This is especially active at the point near the ligature where the stasis of blood is greatest. The fatty tissues that are in the vicinity of the gland and those that come in contact with the glandular parenchyma, show the necrotic process most strikingly. They hold that the escape of pancreatic ferment is necessary to produce fat necrosis, and that there is a relationship between hemorrhage and necrosis, as they find that the latter was most marked in the hemorrhagic areas. Blume<sup>2</sup> speaks of the self-digestion of the pancreas during life. He states, in this connection, that so-called fat necrosis of the pancreas and peritoneum depends upon alteration of the fat within the tissue cells as the result of the action of the pancreatic secretion. To begin with, there is a necrosis of the parenchyma of the pancreas which, he states, may take place during life and is caused by a diminished blood-supply produced by a spasm of the pancreatic arteries.

After studying nine cases of the disease in the hospital at Trieste, D. V. Liebermann,<sup>3</sup> in connection with Cominotti, concluded that changes in the abdominal fat are identical with those occurring in the lobules of the pancreas, and believes that it constitutes a disease *sui generis*, and is equally fatal. This view is not in accordance with the experiences of others, for experiments as well as clinical observations teach us that fat necrosis may result from any disease of the pancreas which gives rise to temporary stasis in the pancreatic circulation and the escape of a special secretion of the gland into its own tissues and the tissues of the surrounding organs. It is possible for this to occur without infection; it is also possible for the infection to play a part in leading to the primary stasis. This shows that the disease is not *sui generis*; and as to its being universally fatal, that is disproven, because numerous cases have recovered after laparotomy which placed the diagnosis beyond dispute. The fact that some patients have had repeated attacks of hemorrhagic pancreatitis, extending over some years, would lead to the con-

<sup>1</sup> Arch. für Verdauung Krank., 1898, Band iv., Heft 3.

<sup>2</sup> Cited, Centralbl. für innere Med., 1898, No. 48.

<sup>3</sup> Revista Veneta, January 15, 1899, tom. xvi.

clusion that fat necrosis had also existed, from which recovery had taken place spontaneously. Many writers neglect to call attention to the factor of toxæmia that patients with pancreatitis and fat necrosis present. I have known cases mistaken for uræmia, obstruction of the bowels, and suppurative appendicitis.

**Pancreatic Calculi.** The symptoms of pancreatic calculus, causing obstruction and stenosis of the duct of Wirsung, are very similar. A. Pearce Gould<sup>1</sup> reported the case of a man, forty-six years old, having a good personal history, who began having severe pain referred to the umbilicus, made worse by walking up hill. Jaundice soon appeared and persisted for three months; the liver was found enlarged, reaching as low as the umbilicus, and the gall-bladder could be distinctly felt. The abdomen was explored and one-half pint of fluid was aspirated from the gall-bladder, at the same time several calculi were found and removed from the duct of Wirsung. The evidence of obstruction persisted, and three weeks later, the patient having suffered a very severe attack of pain in the right epigastrium, the abdomen was reopened and a large stone removed. After this bile was vomited and the stools became colored. A similar case was reported by Kellock, in which the liver was enlarged and the gall-bladder dilated. There was found at necropsy in the head of the pancreas, in the dilated portion of the duct of Wirsung, a calculus the size of a cherry. It is thus seen that biliary obstruction is an important symptom of pancreatic lithiasis.

The appearance of glycosuria, according to Polyakoff,<sup>2</sup> is of value in the diagnosis of pancreatic colic. He reports the case of a robust innkeeper, twenty-eight years old, who had repeated attacks of intense colic a little to the left of the median line and extending to the vertebral column. He lost flesh and developed an enormous appetite and thirst. Examination showed that he had passed three and a half litres of urine daily, containing much sugar. He was relieved by the administration of antipyrin and caffeine, and at the end of a month was well. The author calls it an instance of pancreatic diabetes resulting from pancreatic colic. The symptoms certainly accord with the last-named affection. A. Cipriani<sup>3</sup> mentions the following as the criteria of stone in the pancreatic duct—namely, glycosuria, steatorrhœa, sialorrhœa, general malaise, vomiting, and emaciation, together with the presence of calculi in the feces, with deep-seated pain along the costal border which radiates to the spine and left scapula. To this should be added the thirst and increase in appetite, and the fact that on analysis the calculus is shown to be composed of phosphate of lime.

<sup>1</sup> British Medical Journal, December 17, 1898.

<sup>2</sup> Cited in Bulletin Médical, 1898, No. 47.

<sup>3</sup> Therap. Monats., November, 1898.

**Malignant Disease of the Pancreas.** A careful study of the means of diagnosis of carcinoma of the pancreas, including an investigation of the fat absorption in this disease, is reported by W. P. Northrup and C. A. Herter.<sup>1</sup> They report a case. The patient had a good personal history; he first complained of rheumatism in the back, which continued for six months, and it was so severe as to oblige him to apply at a hospital for treatment. After some weeks he developed diarrhœa, having five or six loose movements daily; this continued until the end of his life. Malignancy was soon suspected, and the growth was located in the pancreas, first, for the reason that gastric cancer could be excluded by chemical and other tests, and for the further reason that the patient had lost seventy pounds in weight; there had developed cachexia, and under chloroform a tumor could be felt in the region of the head of the pancreas. This growth was very slightly movable, did not move with respiration, and occupied the proper position for the greater end of the pancreas. Attention was also called to the character of the stools that apparently contained a great deal of fat. Dr. Herter made a careful examination of the evacuations, and was able to recover 46.76 per cent. of all fats ingested. According to Mueller, the amount of fat passed in the feces of three healthy adults was 7.2, 16.9, and 10.5 per cent. respectively. It will thus be seen that about four times as much fat was lost in this case as could be expected in health. In part this great loss of fat in the stools is to be accounted for by the absence of bile, the stools being acholic. There was also in this case an excessive indicanuria which, according to Herter's previous investigations, is to be accounted for by the activity of the colon bacillus, but it has also been held that indicanuria develops in consequence of the cutting off of pancreatic secretion. It is probable that both these conclusions are correct, and that the diminution of the pancreatic juice and the succeeding intestinal indigestion make it easy for putrefactive changes to occur in the feces. Herter refers to an interesting statement made by Walker, of London, in 1899, that light or stone-colored stools may be found in patients suffering from pancreatic disease when the biliary ducts are in no way complicated.

<sup>1</sup> American Journal of the Medical Sciences, February, 1899.





# GENITO-URINARY DISEASES IN THE MALE, AND SYPHILIS.

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## **PYOGENIC INFECTIONS OF THE GENITAL ORGANS.**

UNTIL 1879, when Neisser announced the discovery of a bacterium, since universally designated the gonococcus, as a constant and characteristic element in the pus of gonorrhœa, the etiology of suppuration in the male urethra was an unexplored field.

Following Neisser's discovery came the confirmation by many observers of the existence of the gonococcus; its presence in the urethral discharge in cases clinically called gonorrhœa; its absence from the pus of traumatism and all other non-venereal inflammations; and the proof by Bumm, Wertheim, Bokai and others that pure cultures of the gonococcus introduced into the virgin urethra cause clinical gonorrhœa. As a result of these researches, it was generally accepted, fifteen years ago, that the urethritis which furnished pus containing a diplococcus with the same morphological and tinctorial qualities as the gonococcus of Neisser was of venereal origin, and all others of non-venereal causation.

In 1884 and thereafter it was asserted by certain careful observers that the morphological and staining features which had been accepted as absolute identification of the gonococcus were not sufficient; that certain bacteria, among them one which makes the urethra its habitat, could not be distinguished by such means from the coccus of Neisser, and that observations based upon this assumption were unreliable. The more decisive means available for the identification of the pathogenic bacteria—the appearance of cultures on artificial media and the induction of characteristic disease by the inoculation of animals—were not usually employed in identifying the gonococcus during the earlier years, because of the difficulty of providing suitable media on the one hand, and the obvious lack of human subjects—the only animals susceptible to inoculation—on the other. In recent years various convenient culture media have been devised and generally employed, and a surprisingly large number of investigators, especially among the Germans, have procured human subjects for inoculation with pure cultures.

The researches of these last few years have proven the impossibility of identifying the gonococcus by its morphological and tinctorial quali-

ties alone, and by consequence they disclose the uncertainty of the conclusions drawn from all such work. The bacteriology of purulent urethritis is being rebuilt on the basis of pure cultures and inoculations, as required elsewhere. The fulfilment of these requirements shows that while the gonococcus is present in probably 90 per cent. of cases of purulent urethritis following sexual contact, yet in a small minority this organism is absent, while certain other bacteria are the pathogenetic agents. Meanwhile, the progress of bacteriology in general had shown that the immediate agent in producing the effects of pathogenetic bacteria is not the organism itself, but products of its metabolism, collectively termed toxins; that the various tissue-reactions of bacterial infection, including suppuration, could be produced by the injection into a susceptible animal of the sterilized toxins from artificial cultures, and that such injection was followed by a more prompt, though more transient, effect than infections with the living bacteria. There followed also the clinical observation that purulent urethritis may occur without bacterial presence, not merely from certain constitutional conditions, such as are produced by gout, by ingestion of capsicum, etc., but also as an immediate sequence and apparent result of sexual contact.

Our present knowledge requires differentiation among the various etiological factors which may produce purulent urethritis, as follows :

1. Venereal infections by the gonococcus.
2. Venereal infections by other pyogenic bacteria.
3. Non-bacterial venereal urethritis, perhaps from gonococcus or other toxins.
4. Auto-infection of the urethra from colonies of bacteria (gonococcus or other) in various recesses of the genital canal.

**Gonococcus Infection.** The demonstration that certain other bacteria cannot be distinguished by appearance or staining from the gonococcus vitiates many of the older observations and renders very acceptable some recent proofs, by culture and by inoculation of the human urethra, that the gonococcus does really invade the blood, serous membranes, tendon-sheaths, etc., in the condition termed gonorrhoeal rheumatism, which may, therefore, be a veritable gonococcus pyæmia.

Noteworthy among the many recent researches on the metastasis of the gonococcus are those of Ahman, Jundell, Colombini, Ghon, and Schlagenhauer.

Ahman<sup>1</sup> discovered in the blood of a patient suffering from gonorrhœa, affecting the shoulder, finger, left tibialis anticus muscle, and right hip, diplococci which had the form, staining qualities, and culture appearances of the gonococcus, and a pure culture of which inoculated into the

<sup>1</sup> Arch. f. Dermatol. und Syph., June, 1897.

urethra of a young man produced gonorrhœa, infarct of the lung, and tendovaginitis lasting three months. Jundell<sup>1</sup> identified as the gonococcus, by successful inoculation of pure cultures, the diplococci found in a tendovaginitis (posterior tibial muscle of the right leg), also in the exudate of a knee-synovitis in a second case. Colombini<sup>2</sup> identified by cultures the gonococci found in several abscesses developed during the course of a gonorrhœa—in epididymis, inguinal and parotid glands—and in the blood of the same patient found gonococci, identifying them by inoculation of pure cultures in another man, with the production of "florid" gonorrhœa lasting several months. This patient had nephritis, but no gonococci were found in the urine aspirated from the bladder; the nephritis was, therefore, ascribed to toxins circulating in the blood.

Ghon and Schlagenhauser's<sup>3</sup> case was a girl, who exhibited during an attack of gonorrhœa an endocarditis and gangrene of the foot. At the autopsy the heart-valves were found infected with gonococci, which were identified by staining, by pure cultures, and by inoculation of the tenth generation into the urethra of a man, who forthwith developed typical gonorrhœa. The gangrene of the foot was due to thrombus of the femoral artery, which, however, contained neither gonococci nor other bacteria.

Jullien and Sibut<sup>4</sup> by cultures identified as gonococci the bacteria found in the blood in a case of gonorrhœa with inflammation of the mitral valves and of various joints; Rendu<sup>5</sup> identified by cultures gonococci from an endocarditis and peri-arthritis of the left elbow in a woman; Heiman<sup>6</sup> identified by cultures gonococci found in the pus of the wrist-joint in a new-born child two weeks after the development of gonorrhœal ophthalmia. By the same method there was established the identity of gonococci found in the blood, pericardial exudate and cardiac vegetations by Thayer and Lazear;<sup>7</sup> on the tricuspid valves by Lenhartz<sup>8</sup> (who also induced typical gonorrhœa by inserting a piece of the cardiac thrombus into a human urethra); in an abscess of the hand by Harwitz and Paltauf;<sup>9</sup> in an intramuscular abscess by Bujwid;<sup>10</sup> in tendovaginitis, arthritis, and pleurisy by Jacobi, Young and Bordoni-Uffreduzzi respectively.

Observations such as these prove not only that the gonococcus may enter the blood of human patients and induce metastases, but also that it

<sup>1</sup> Arch. f. Dermatol. und Syph., May, 1897.

<sup>2</sup> Centralbl. für Bakteriologie, Band xxiv., No. 25.

<sup>3</sup> Wien. klin. Wochenschrift, 1898, No. 24.

<sup>4</sup> Annales d. Mal. d. Organe Genito-Urinaire, 1898, p. 870.

<sup>5</sup> La Semaine Médicale, 1897, No. 54.

<sup>6</sup> N. Y. Medical Jour., January 15, 1898.

<sup>7</sup> Journal of Experimental Medicine, January, 1899.

<sup>8</sup> Berliner klin. Wochenschrift, 1897, p. 1138.

<sup>9</sup> Wien. klin. Wochenschrift, 1893, p. 59.

<sup>10</sup> Centralbl. f. Bakteriöl., 1895, p. 435.

is not of necessity, on serous membranes at least, a pus producer, since in many of the affected joints and tendon-sheaths in the cases described no pus was discovered. That this organism does in certain cases cause diffuse peritonitis is shown by Cushing's<sup>1</sup> careful study of two autopsied cases of general peritonitis following gonococcus infection of the genital canal.

Infection of the mouth and rectum with severe reactive inflammation has been proved to be due to gonococci, through cultures, by Jesionek and Mantegazza respectively.

**GNOCOCCLUS TOXINS.** While gonorrhœal rheumatism, so called, is frequently a gonococcus blood-infection, with metastases in the affected joints and other tissues, yet many observations indicate that marked constitutional disturbances may accompany the urethral infection without the institution of secondary foci in other tissues. The rise of temperature, erythemas, purpura, and keratoses incidental to gonorrhœa have long been known and albuminuria has been often noted. The frequency of renal albuminuria during gonorrhœa is stated by Goldberg<sup>2</sup> to be 12 per cent. of all cases. Colombini<sup>3</sup> examined for albuminuria the urine of 372 cases of gonorrhœa; of 300 cases, in which the infection was limited to the urethra, 24 had albuminuria; of 72 cases, with extension of the infection to the epididymis, 42 had albuminuria. It would seem that the large percentage (58.3) of albuminuria in the latter class, as compared with the former, must be ascribed not directly to the toxæmia, but to the spasmodic vesical contractions, and consequently increased urinary pressure in the ureter and kidney pelvis, which usually occur when the gonococcus invades the prostatic urethra; for renal albuminuria is frequent in cases of strangury from any cause, subsiding when the vesical spasms cease. Probably Goldberg's 12 per cent., or Colombini's 8 per cent., in simple gonorrhœa more nearly represents the actual ratio of renal albuminuria due directly to the presence of the toxins in the blood.

Pain, with or without swelling, is sometimes experienced in various joints during the course of a gonorrhœa, leading the physician to expect metastatic infections, yet subsiding without any of the severe effects of such localizations; and similar evidences of inflammation are noticed in other localities—iris, retina, pleura, peritoneum, various muscles and tendons, especially of the lower extremities. The meninges also may display evidences of irritation—phenomena to which Venturi first called attention; thus, Coulouma<sup>4</sup> relates a case in which a young woman exhib-

<sup>1</sup> Bulletin of Johns Hopkins Hospital, May, 1899.

<sup>2</sup> Monatshefte f. prakt. Dermatol., Band xxiii.

<sup>3</sup> Annales d. Mal. d. Organe Genito-Urinaire, July, 1898.

<sup>4</sup> Virchow's Archiv, Band xcvii. p. 528.

ited mania and hallucinations which began with a gonorrhœa and ceased when the local disease subsided.

These various phenomena are indicative of toxæmia; analogy with other bacterial diseases permits the assumption that the toxins may be the products of the cocci floating in the blood, or of those localized in the genital canal—a blood infection or an intoxication. Direct observation has never proved the presence of this bacterium in the blood, so far as I am aware, except in cases where secondary metastatic infections were detected, and there is ample proof that the sterilized toxins of the gonococcus introduced into the circulation produced some, at least, of the phenomena above mentioned. Thus, Wassermann<sup>1</sup> found that these toxins injected subcutaneously produce local pain, fever, and painful swelling of joints. Gross and Kraus<sup>2</sup> abundantly confirm this statement, and Moltschanoff<sup>3</sup> observed that the injection of toxins into a vein or the peritoneal cavity of white mice, rabbits, and guinea-pigs was followed by immediate and pronounced changes in the cells of the spinal cord and brain.

The gonococcus infection is, therefore, not simply nor always a local disease; it is usually accompanied by more or less toxæmia; it may invade by continuity the entire sexual and urinary canals and peritoneum; it may be carried by the blood and establish secondary infection of all serous membranes, tendon-sheaths, periosteum, skin, muscle, iris, and retina. It is, then, always possible that the local infection may give rise to either septicæmia or pyæmia, both of which conditions have been designated by the clinical term "gonorrhœal rheumatism."

**Infection with Other Pyogenic Bacteria.** So long ago as 1886 Bockhart maintained that the gonococcus was not the only bacterium capable of exciting purulent urethritis, and adduced in evidence fourteen cases of this disease, the pus from which contained no gonococci, but two other varieties of coccus. He succeeded in making artificial cultures of these and in inducing an acute, though relatively mild and brief, urethritis by implanting them on healthy urethras; and he found similar organisms in the sexual channels of women. Since that time reports of such cases by competent observers have been so numerous that the existence of acute venereal infectious urethritis, independent of the gonococcus, and caused by other pyogenic bacteria, has been established beyond cavil.

The identification of these species has not progressed so satisfactorily, though three varieties seem to have been fairly well established. The first of these is the so-called "PSEUDOGONOCOCCUS," first described by Bockhart, and detected in the genital canal of both sexes by various

<sup>1</sup> *Annales d. Mal. d. Organe Genito-Urinaire*, May, 1898.

<sup>2</sup> *Arch. f. Dermatol. und Syph.*, 1898, p. 329.

<sup>3</sup> *Münch. med. Wochenschrift*, May 1, 1899.

observers since. This organism is indistinguishable from the Neisser coccus by morphological and tinctorial features, but presents distinct peculiarities in culture, as recently described by Noguès and Wassermann,<sup>1</sup> who object to the term "pseudogonococcus" as unnecessarily confusing. The proof of the existence of this bacterium vitiates many of the earlier assertions concerning the gonococcus, whose identity was considered established without culture or inoculation. While I am not able to dismiss the possibility that this pseudogonococcus may be the Neisser bacterium modified by environment (for we know that the virulence of the gonococcus, like that of the pneumococcus, diphtheria bacillus, and other pathogenic bacteria, is easily diminished artificially, and that the other organisms named exhibit a wide range of virulence clinically), yet the weight of evidence certainly indicates the existence of two distinct species.

In other cases of urethritis the STAPHYLOCOCCUS AUREUS has been found in numbers indicating its causative relation; it may also cause secondary epididymitis, as in the case observed by Le Grain.<sup>2</sup> A short bacillus resembling the familiar colon bacillus has been found in pure culture in the pus of venereal urethritis by several observers, and has been called by some the colon bacillus. Janet reported to the French Urological Association two cases of clinical gonorrhœa derived from the same woman, and describes the pus as a pure culture of a short bacillus, but he gives the organism no name. The vaginal and urethral secretions of the woman from whom these two men derived the infection contained no bacillus of this appearance, but she was the subject of chronic cystitis, and her urine contained various species of cocci (no gonococci) and many bacilli identical with those causing the urethritis of her patrons. Upon this rather flimsy basis Janet erects the hypothesis that cystitis of the female may infect the urethra of the male with this organism, and accordingly speaks of "venereal infection from vesical disease." When we consider the frequency of vesical infection by the colon bacillus without the slightest inflammation of the urethra, which is flushed every few hours for weeks at a time with the bacillary contents of the bladder, and when we recall the fact that the colon bacillus is one of the common inhabitants of the vulva (in 50 per cent. of women, according to Melchior), we may find difficulty in regarding this bacillus as the frequent cause of purulent urethritis. Yet here, as elsewhere in bacteriology, we must consider the soil as well as the seed; the failure to infect many urethras with the colon bacillus does not prove the impossibility of infecting others. Noguès reported to the French Association in 1898 twenty-six cases of non-gonorrhœal urethritis caused by five bacterial species—two bacilli

<sup>1</sup> Annales d. Mal. d. Organe Genito-Urinaire, July, 1899.

<sup>2</sup> Ibid., 1899, p. 706.

and three cocci. Eraud<sup>1</sup> observed primary purulent venereal urethritis in two cases without gonococci; one began three days after the last coitus and presented the clinical picture of gonorrhœa; the pus contained numbers of short bacilli. Three years later this same patient contracted another gonorrhœa, the pus containing the usual gonococci. Gross and Kraus<sup>2</sup> found that pure cultures of various bacteria commonly found in the genitals of both sexes, such as the bacillus pyocyaneus, bacillus coli, and staphylococcus aureus, injected into the urethra produced a brief urethritis which subsided without treatment in a few days, and that the same effect followed the injection of other sterilized toxins.

While, therefore, our present knowledge does not enable us to positively classify the various bacteria, other than the gonococcus, which cause purulent urethritis of venereal origin, yet it is established beyond dispute that there are such; that in a small minority of cases urethritis may follow sexual contact without the agency or presence of the gonococcus of Neisser. The clinical importance of this fact is apparent.

**Bacteria of the Normal Urethra.** In this connection may be mentioned some of the later studies of bacteria found in the healthy urethra, first undertaken by Lustgarten and Minnaberg in 1887. Pettit and Wasserman (1891), Krogus (1892), Melchior (1893), Franz (1896), Posner and Lewin, found a minority of urethras sterile; but many, even those which have never been submitted to instrumentation nor been infected with gonorrhœa, furnished bacteria of many varieties, the staphylococcus and streptococcus predominating. It is noteworthy that the colon bacillus, so commonly found not only in the normal intestine but also on the vulva, glans penis, and foreskin, has seldom been found in the normal urethra of either sex, nor even in that channel when diseased. Faltin<sup>3</sup> examined the secretions from the urethra in fifty-one surgical cases especially to determine the presence of the bacillus coli. Though many of these had been the subjects of gonorrhœa and urethral instrumentation, the colon bacillus was detected in only two; one of these had been catheterized shortly before, and the other had a urethral discharge. These findings strengthen the suspicion, based on other data, that the colon bacillus enters the bladder, where it is so often found, through some channel other than the urethra—probably direct from the rectum or by way of the blood and upper urinary channel.

**Non-bacterial Urethritis.** For many years after the work of Ogston and Rosenbach it was believed that suppuration was always and essentially due to bacterial invasion. Since then the laboratory production of pus by the action of croton oil, turpentine, etc., and finally the proof that the toxins of many bacterial species were pyogenic, make it

<sup>1</sup> Revue de Médecin, May 16, 1898.

<sup>2</sup> Loc. cit.

<sup>3</sup> Centralbl. f. Krankheiten d. Harn. u. Sexuale Organ, 1898, p. 552.

plain that suppuration is merely the reaction of the tissues to certain chemical irritants. Clinically, there has long been an unproven belief that purulent urethritis could be produced by the gouty condition, diabetes, the ingestion of capsicum and other irritants eliminated by the kidneys. While that belief still lacks positive demonstration, there is proof that venereal contact may be followed by purulent urethritis, the pus from which contains no bacteria revealed by expert examination. This was established by the classical case in which Neisser failed to find any bacteria in the pus from the urethra of a man who, a few days after returning to his wife from a long absence, developed purulent urethritis, and brought suit for divorce, offering his disease as evidence. Janet, Noguès and others have reported cases of non-bacterial or "aseptic" urethritis; Hogge alone observed twelve such. In some of these the patient has been plainly gouty, or neurasthenic, or both; in Le Fur's<sup>1</sup> case the non-bacterial urethritis developed simultaneously with genital herpes, in such a man, after congress with his wife, who was suffering from menstrual herpes; the discharge lasted four weeks. On a subsequent occasion the herpes occurred without urethritis.

The causative agent in these cases is still a matter of speculation. Three possibilities are apparent: the irritant may be a toxin derived from gonococci or other bacteria infecting the female sexual canal. This hypothesis is supported not only by our knowledge of the pathogenetic effect of toxins from the staphylococcus, etc., but also by direct demonstration of such qualities of the gonococcus toxins. It has been proven that toxins from pure cultures of the gonococcus induce suppuration not only in the joints of rabbits, but also in the human urethra (Schäffer,<sup>2</sup> de Christmas,<sup>3</sup> Nicolaysen<sup>4</sup>); also, that the toxins of the common pus bacteria cause brief urethral suppuration (Gross and Kraus<sup>5</sup>). This explanation may account for acute urethritis beginning within twenty-four hours after contact and ceasing within a few days, as observed after the experimental inoculation with gonococcus and other toxins above mentioned; but it would fail to explain cases like the one reported by Janet,<sup>6</sup> in which the discharge is said to have appeared fifteen days after exposure, and to have lasted many days. Another hypothesis assumes that the suppuration is started by the action of bacteria which quickly disappear, or by such as escape detection by the methods generally employed, as did the tubercle bacillus in the early days of bacteriological research. The most plausible explanation of non-bacterial urethritis is

<sup>1</sup> Centralbl. f. Krankheiten d. Harn. u. Sexuale Organ, 1898, p. 41.

<sup>2</sup> Fortsch. d. Med., 1897, No. 21.

<sup>3</sup> Annales de l'Institut Pasteur, August, 1897.

<sup>4</sup> Centralbl. f. Bakteriologie, 1897, Nos. 12 and 13.

<sup>5</sup> Annales d. Mal. d. Organe Genito-Urinaire, 1898, p. 881.

<sup>6</sup> Loc. cit.



this : In some cases, beginning within twenty-four hours and ending in a few days, the cause is a toxin produced in the female genitals, and inoculated in the male urethra ; many others are caused by toxins from colonies of bacteria, gonococci or others, which have been previously introduced into the male organs and have lain dormant for a time, but are aroused into activity by the congestion incidental to sexual indulgence. Persistent bacterial infection of the deeper parts of the sexual canal—prostate and seminal vesicles—probably explains many cases of non-bacterial urethritis.

The pyogenic action of the toxins of the gonococcus as well as of other pus bacteria seems to have an important clinical bearing which has been often overlooked, for we not infrequently meet cases of profuse urethral suppuration following within a day a suspicious sexual connection, yet subsiding under any treatment within a few days. Many of these are, of course, instances of auto-infection from the man's own urethra, an uncured gleet being aggravated by the sexual excitement ; yet others cannot be thus explained. Thus I have observed two cases in which the husband usually had a brief purulent urethritis after each contact with his wife, but not after intercourse with other women, these attacks subsiding spontaneously within a few days. The wife in each case had profuse leucorrhœa, but no gonococci could be discovered.

**Auto-infection of the Male Urethra** from colonies of gonococci in the various recesses of the sexual canal is a frequent clinical occurrence. The discharge appears within forty-eight, usually within twenty-four hours, and subsides under indifferent treatment within two or three weeks, sometimes within five or six days. These cases are often mistaken for acute gonorrhœa ; the mild and brief course misleads the patient into a light estimate of that disease, and the physician into an exaggerated belief in the value of the remedies that he may have employed.

**Importance of Diagnosis.** The diagnosis of true gonorrhœa—gonococcus infection—is, therefore, a most important and not always a simple matter ; it is not synonymous with purulent urethritis, since the latter may be produced by inoculation of toxins from the vagina, by infection with bacteria other than the gonococcus, by syphilis, and by aggravation of a chronic gonorrhœa without gleet. For clinical purposes we may be satisfied with the symptoms of severe urethritis, and with the presence in the pus-cells of diplococci decolorized by the Gram method ; but in cases where critical diagnosis is important we must at least secure the additional proof of cultures. In a recent case the subject of acute gonorrhœa acquired spinal meningitis ; lumbar puncture procured a purulent fluid rich in intracellular, kidney-shaped diplococci, which were decolorized by Gram's method—thus far identical

with gonococci; but cultures proved them to be the diplococcus of Weichselbaum.

It is true that the gonococcus infection overshadows all other causes of purulent urethritis in frequency, persistence, and importance; and that the physician who gives to all cases of urethritis of venereal origin the treatment for gonorrhœa is doing no wrong to the patient's anatomy at least; but many other factors involved in individual cases require accurate diagnosis with the use of all possible means of precision, for in some instances the physical are overshadowed by the moral features of the case.

**Chronic Gonorrhœa and Gleet.** The error of considering these terms synonymous has been emphasized by recent researches. It is fully established that a gleet may persist during many months, though no gonococci, but merely the common pus bacteria, can be discovered in the pus; conversely, a chronic gonococcus infection may persist for a long period after all gleet—*i. e.*, discharge from the meatus—has ceased. In many of these cases of what may be properly termed "latent gonorrhœa" there may be detected a gumming of the meatus in the morning; or the urine may contain pus, either in the form of threads or as a diffuse cloud; yet in some cases infection foci are not washed by the urinary stream, but are emptied by the vigorous compression of the entire sexual canal incidental to the ejaculation of semen. These foci of infection are in the prostatic follicles, the utricle and the seminal vesicles, all of which can be, at least in part, evacuated by digital pressure from the rectum. The expression and examination of the contents of these cavities is essential before pronouncing the subject of recent gonorrhœa free from infection, though intercourse with ejaculation into a condom is the most satisfactory method of securing specimens in doubtful cases.

**PERSISTENCE OF THE INFECTION.** The average persistence of the gonococcus infection after apparent cure is still exaggerated in the popular medical mind. The teachings of Noeggerath in 1870—that gonorrhœa is never cured—are still echoed even by professional teachers of medicine. Noeggerath's conclusions were necessarily speculative in large measure, because the discovery of the gonococcus and the consequent possibility of positive diagnosis did not occur until 1879. Extended clinical observations agree with the microscopical findings of Goll, that the gonococcus usually (90 per cent. of cases) disappears from the genital canal in three to six months after infection; that its persistence for two or more years occurs in less than 3 per cent. of cases; and that the instances like those recorded by Brewer, Oberlaender, and Wossidlo—in which the gonococcus infection seems to have been persistent from five to nine years—are extremely rare. Owings<sup>1</sup> found gonococci in

<sup>1</sup> Bulletin of Johns Hopkins Hospital, No. 79.

only five out of fifty cases of gleet that had lasted from six months to three years ; in one, the specific coccus was present two years after infection. Heiman<sup>1</sup> found the discharge in fifteen cases of chronic urethritis entirely free from gonococci, as judged by cover-glass preparations and cultures. Tano,<sup>2</sup> examining the urethral filaments in thirty cases of chronic gonorrhœa, found the gonococci in only one case, the staphylococcus and streptococcus often, and twenty-six other bacterial varieties in the various cases. Cohen<sup>3</sup> made a careful examination by cultures of secretions from the deep urethra and prostate in twelve cases of chronic gonorrhœa of one or more years' duration ; he found no gonococci, but staphylococci in eleven, streptococci in three, and colon bacilli in one. The frequent clinical observation that a husband's gleet may cause no symptoms of gonorrhœa in his wife is explained by these researches.

**Chronic Non-venereal Urethritis.** The prevalence of gonorrhœa and the proneness of human males to indulge the procreative instinct have inclined the medical mind to ignore the possibility of non-venereal inflammation of the genital tract. There are, however, many cases of chronic purulent urethritis due to infection of the prostatic urethra and seminal vesicles of non-venereal origin. Many prostatis have a chronic discharge from the meatus, due to suppuration in the prostatic follicles and seminal vesicles, which is promptly stopped by milking these organs from the rectum. One patient of mine, seventy-five years old, had not even had an erection for years before the beginning of a discharge which simulated gonorrhœa ; it proceeded from the prostate, and was promptly cured by massage of that organ. These cases are numerous in men between fifty and sixty-five years of age, who exhibit the chronic catarrhal inflammation of early prostatic enlargement. Infection of the prostate occurs from the bladder, urethra, or rectum ; a case of non-venereal colon-bacillus infection of the seminal vesicles has been described.<sup>4</sup>

**Sequelæ. STERILITY.** Another of Noeggerath's speculations—that an attack of gonorrhœa involves great danger of masculine sterility—is disproven by the observations of recent years. Thus, Benzler<sup>5</sup> reports that he followed the marital history of 474 men, who as soldiers were treated for gonorrhœa, and who subsequently married ; 410 of these (87 per cent.) became fathers within three years. Since the sterility in some of the remaining marriages (13 per cent.) may have been due to defects in the women, and since nearly 20 per cent. of marriages in general are sterile, it would seem that these subjects of previous gonorrhœa possessed at least the average fecundity. Sterility followed in 10 per cent. of the

<sup>1</sup> Journal of Cutaneous and Genito-Urinary Diseases, March, 1898.

<sup>2</sup> Centralbl. f. Krankheiten d. Harn. u. Sexuale Organ, 1896.

<sup>3</sup> Ibid., 1898, p. 229.

<sup>4</sup> Annales d. Mal. d. Organe Genito-Urinaire, 1897.

<sup>5</sup> Arch. f. Dermatol. und Syph., Band xlv., Heft 1.

cases of urethral gonorrhœa, in 23.4 per cent. of cases with unilateral epididymitis, in 41.7 per cent. of cases with double epididymitis. I have myself seen pregnancy occur within four months after both husband and wife were infected with gonorrhœa; and a bride infected by a chronic gonorrhœa of the husband became pregnant three months after the wedding.

**IMPOTENCE.** One of the disastrous effects of gonorrhœa is the impairment or even extinction of the virile power through damage to the prostatic urethra by the inflammatory process; imperfect erection, premature ejaculation, and loss of the normal sensation accompanying emission are the prominent results, apparently due to the destruction of nerve-endings in the mucous membrane. The consequent impotence may be transient or permanent.

**Treatment.** New remedies and new methods enthusiastically warranted to cure gonorrhœa quickly, surely, and safely have been launched almost as numerous in these latter as in former years. That none of these is the desired specific; that each falls far short of the claims made for it, is to be expected, because all of them are local applications. One familiar with the anatomy of the genital canal, with its numerous glands and many narrow-mouthed lacunæ, and with the fact that the gonococci early invade the subepithelial tissues, is necessarily skeptical as to the eradication of a urethral infection by any injection, however destructive to gonococci in the test-tube. It would seem that the real cure for gonorrhœa must come through the blood-current. The explanation of the frequent mistake in claiming results that cannot be secured by others, lies, doubtless, largely in the failure to differentiate a fresh gonococcus infection from the other causes of purulent urethritis already mentioned—the aggravation of an uncured chronic gonorrhœa, infection by pus bacteria, and inoculation with toxins—all of which may subside promptly under indifferent treatment or even without treatment.

Of the numerous innovations in the treatment of gonorrhœa two deserve mention: irrigation with potassium permanganate solution and injection with various albumin compounds of silver—argonin, protargol, and largin.

**THE PERMANGANATE IRRIGATION METHOD**, which originated with Feleki, of Budapesth, and has been popularized by Janet, of Paris, possesses two essential features: irrigation with large quantities of the solution and extension of the medication to the deep urethra early—*i. e.*, the third day of treatment, without the use of a catheter. The passage of fluid along the entire urethra into the bladder may be accomplished without a catheter and without injurious hydrostatic pressure in the anterior urethra by having the patient voluntarily relax the cut-off muscle (the membranous urethra), which alone opposes the entrance of fluid into

the deep urethra. The patient can almost invariably learn to do this by simply taking a deep breath and making an effort to urinate; the irrigating fluid which fills the urethra when this effort is made passes readily into the bladder, even when the hydrostatic pressure is slight (as it always should be).

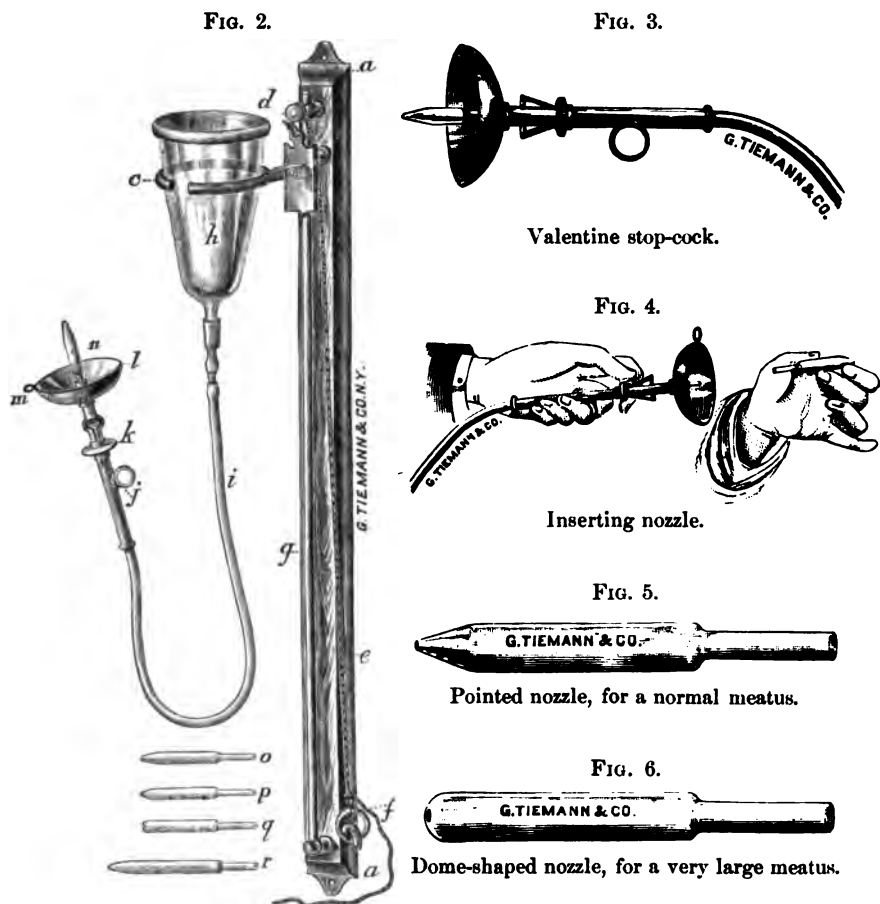


FIG. 2.—Valentine urethral and intravesical irrigator: *a*, board with attachments to be screwed to wall; *c*, open collar; *d*, pulley; *e*, cord; *f*, ring to suspend percolator; *g*, brass rod; *h*, percolator; *i*, rubber tube; *j*, ring for fourth finger; *k*, flange to graduate pressure; *l*, shield; *m*, ring to suspend shield; *n*, nozzle attached.

This method requires that the patient make two visits daily to the physician for the first four days, receiving at each visit an irrigation of the anterior urethra, and on the third and fourth day an irrigation of the deep urethra also. The solution consists at first of 1 part of the permanganate to 4000 of water, the exact strength and other details varying with circumstances. From the fifth day the patient receives one

complete irrigation daily until fourteen in all have been given ; if gonococci are still present, or if the discharge recurs, another series of ten irrigations is given. About a quart is used for each irrigation.

While these irrigations may be made from an ordinary fountain-syringe, yet convenience is attained by the use of certain special appliances as indicated in Figs. 2 to 8. The patient bares his body from hip to knees, attaches a rubber apron with a hole in the centre through which the penis is passed, sits upon a firm chair, sliding forward almost into a semi-recumbent position, and holds a large basin in both hands under the penis ; the physician directs the stream from the irrigator upon the glans penis, sulcus, and foreskin, cleaning these before introducing the nozzle into the meatus.

The advantages claimed for this method by Janet, Brewer, Valentine and others are immediate relief of pain and scalding upon urination, and rapid cure of the disease. Goldberg<sup>1</sup> asserts that the results in his hands

FIG. 7.



Blunt nozzle, for a very small meatus.

FIG. 8.



Triple length nozzle, for the female urethra and bladder.

have been 60 per cent. of cures in ten days, 30 per cent. in fourteen days, 5 per cent. in variable longer periods, while 5 per cent. were failures—90 per cent. cured in fourteen days or less. Others report results almost as favorable, while some make more modest claims. While this method requires far more of the patient's time during treatment than the older methods by auto-injection, yet the brief period of treatment renders the actual loss of time insignificant in comparison with the results claimed. Motz advises that the irrigation be employed throughout the entire urethra from the first day, and reports seven out of nine cases thus cured in nine days.

My own observation of this method has shown results distinctly less favorable than those above mentioned. While the irrigation method, especially of the deep urethra, is certainly preferable to the incomplete application by hand syringes and catheters, the potassium permanganate seems to me inferior to other agents, though I have not been able by

<sup>1</sup> Centralbl. f. Krankheiten d. Harn. u. Sexuale Organ, Band vii.

any local treatment to cure 90 per cent. of acute gonococcus infection within fourteen days.

PROTARGOL, ARGONIN, LARGIN, SILVER COMPOUNDS WITH ALBUMIN RECOMMENDED FOR URETHRAL IRRIGATION. The first alone seems to have secured general favor. Neisser,<sup>1</sup> who introduced it, recommends that this solution be injected three times daily, and that each injection be retained ten to fifteen minutes at first, and thirty minutes later. He states that the gonococci usually disappear from the discharge in twenty days, after which astringent injections, such as the zinc salts, must be used until the discharge ceases. Other observers have had equally good or better results; thus Baum<sup>2</sup> reports fifty carefully observed cases treated with protargol; of these, fifteen were uncomplicated cases of first infection, and in these the discharge ceased in thirteen days on the average, though the gonococci were found in some cases until the seventeenth day. He used solutions of 1 to 5 grains to the ounce, six to eight injections daily, retained for five minutes each during the first fourteen days, after which zinc sulphate solutions were employed. Swinburne and others have combined the two methods, using the permanganate irrigation and directing the patient to use protargol injection.

My own experience with protargol has been more favorable than with the permanganate irrigation. I have used irrigation with protargol solution (1 : 1000) once daily, flushing the deep urethra so soon as the first signs of its involvement became apparent, and allowing the patient to use the injection at home. I have combined this with the remedy used by me for twelve years—the yellow muriate of hydrastine, 1 : 1000, dissolving both hydrastine and protargol in the same solution.

The essentials of the irrigation method—large quantities of the solution, and flushing the entire urethra without a catheter—are certainly valuable improvements in the treatment of gonorrhœa. While the potassium permanganate is still the most widely used agent, I am inclined to think that much of the benefit ascribed to this remedy belongs chiefly to the method, and that the permanganate is already being supplanted by other remedies, notably protargol. My own long experience with the yellow hydrastine muriate is extremely favorable.

Some men of wide observation, among them Taylor, of New York, have abandoned the permanganate method, asserting that while it does cause an immediate abatement of symptoms in acute gonorrhœa, it favors the persistence of the infection into the chronic stage and increases the percentage of extensions into the deeper parts—prostate, vesicles, and epididymis. These assertions are warmly refuted by the adherents of the Janet method; my own impression is that they are correct.

<sup>1</sup> Dermatologische Centralblatt, 1898, No. 1.

<sup>2</sup> Medicine, July, 1899.

There are certain old and valuable aids in the treatment of gonorrhœa which are generally ignored because of their inconvenience; thus rest in bed has long been known to materially shorten the course of this disease; the general conviction that the gonococcus infection is always a disease of dangerous possibilities may ultimately reconcile patients to the embarrassment and loss inseparable from its employment. The maintenance of an extreme temperature of the urethra—the highest or lowest compatible with the integrity of the tissues—is another valuable aid. Irrigation with very hot solutions, which had considerable popularity under Curtis' auspices years ago, is very inconvenient; reduction of temperature in the urethra by injections of ice-water and ice-compresses is again advocated by Behrend.<sup>1</sup>

**TREATMENT OF CHRONIC GONORRHOEA AND GLEET.** The gonococcus infection usually invades the deep urethra, prostatic follicles, utricles and seminal vesicles; its persistence in these parts may or may not be accompanied by a gleety discharge, threads in the urine and pain in the rectum, perineum, suprapubic and sacral regions. For the dislodgement of the infection from these less accessible parts of the genital canal there are three important measures—the passage of large sounds (even when no stricture exists), irrigation of the deep urethra, and massage of the prostate and vesicles by the finger in the rectum. Large sounds are useful by expressing infectious material out of the numerous follicles and by massaging the sites of inflammatory exudates. The various urethral dilators constructed on the umbrella principle—Tuttle's, Oberlaender's, Kollmann's—have obvious advantages over cylindrical sounds.

Medication of the deep urethra was formerly practised by injecting small quantities of caustic solutions—*e. g.*, silver nitrate—through a Guyon, Ultzmann, or Keyes syringe; it is now preferably done by irrigating the entire urethra from meatus to bladder (without the aid of a catheter) with several ounces of mild solutions—silver nitrate, 1:5000; zinc permanganate or iodide, 1:3000; yellow muriate of hydrastine, 1:1000; protargol, 1:1000, etc. Any of these may be injected by the patient himself, if he will learn to relax the cut-off muscle by taking a deep breath and making the effort to urinate while the irrigating fluid is flowing into the urethra. The hard-rubber piston instruments, holding several ounces (such as Ultzmann's), are more convenient than the fountain syringe. After several ounces have been injected the patient empties the bladder, thus washing the surface a second time with the solution.

Massage or "milking" of the prostate and vesicles is an extremely valuable therapeutic advance in the treatment of chronic gonorrhœa and

<sup>1</sup> Berliner klin. Wochenschrift, 1898, No. 6.



gleet, much of the credit for which belongs to Fuller. The pressure exerted on the anterior wall of the rectum by the finger (enclosed in a rubber condom anointed with glycerin) accomplishes two important results: expulsion of the contents of the dilated utricle, prostatic follicles, and seminal vesicles; and the improvement in nutrition that follows massage of chronically inflamed tissues. The addition of this milking process—performed for three to five minutes once in four or five days—to the use of sounds and injections, reduces to a small number the cases of incurable gleet.

The various ingenious urethroscopes devised in recent years have not as yet made any material additions to our knowledge of or ability to cure chronic urethral inflammations.

EXCISION OF THE SEMINAL VESICLE for chronic gonorrhœal inflammation, after failure of the milking process, has been successfully practised by Fuller<sup>1</sup> in three cases and by Moullin<sup>2</sup> in one. I myself<sup>3</sup> in two cases incised and packed the vesicle from the rectum (two small concretions were found and removed in one case).

These operations will hardly become popular, since their severity is disproportionate to the morbid condition requiring relief; but incision of the vesicle for acute suppuration, practised and advised by Lloyd in 1889, is a valuable measure.

## PYOGENIC INFECTIONS OF THE URINARY TRACT.

Recent years have been prolific of diligent research and wordy discussion as to the identity of the bacterial agents in the infections of the urinary tract. The doctrine of the Guyon school, as presented in a very elaborate report to the French Urological Association, in October, 1898, by Albarran and Halle,<sup>4</sup> is that the most frequent agents in the production of cystitis are the bacillus coli, staphylococcus, proteus, streptococcus, and gonococcus in the order named; less frequently met are the typhoid bacillus, Fraenkel's diplococcus, and Friedländer's bacillus. In their experience the bacillus coli is distinctly the most frequent and important agent in the infections of the urinary tract.

Rovsing<sup>5</sup> assigns to the bacillus coli a relatively insignificant place as a cystitis producer. He admits that it is frequently found in the urine, generally of acid reaction; but maintains that when it is the only bacterium present there is rarely cystitis, though sometimes a mild pyelitis; and he regards the colon bacillus as comparatively inoffensive in the urinary

<sup>1</sup> Journal of Cutaneous and Genito-Urinary Diseases, September, 1896.

<sup>2</sup> British Medical Journal, November 5, 1898.

<sup>3</sup> Park's Surgery, vol. i. p. 515.

<sup>4</sup> Annales d. Mal. d. Organe Genito-Urinaire, November, 1898.

<sup>5</sup> Ibid., November, 1897, to March, 1898.

as in the intestinal tract. The severe cystitides, he maintains, are caused by pyogenic bacteria which decompose urea (*b. coli* does not), such as staphylococcus, streptococcus, proteus, and *b. pyocyaneus*. There exists also a catarrhal, non-suppurative disease of the urinary tract, which is provoked by the non-pyogenic bacteria that decompose urea, such as the micrococcus ureæ. He asserts that cystitis—*i. e.*, infection by urea-decomposing bacteria—is cured by silver nitrate solution so usually that this injection becomes a diagnostic as well as a curative measure; the bladder is washed until clean; 50 c.c. of a 2 per cent. silver nitrate solution are injected; after two minutes this is followed by an equal quantity of water, and the entire injection allowed to remain in the bladder. If the cystitis is not cured the case is a colon bacillus infection, and probably of the pelvis rather than of the bladder; and the *b. coli* infection is often suggestive of renal calculus. Melchior maintains that the urea-decomposing bacteria as well as the colon bacillus can produce cystitis without abolishing the acid reaction of the urine.

The practical point in the entire controversy is the rôle to be ascribed to the *b. coli*, and the differences of opinion on this subject seem relatively insignificant. The general experience accords with that of the French school.

The essential, clinically important fact about cystitis and pyelitis is that they are not primary affections, but are secondary to some impairment of nutrition; that none of the pyogenic bacteria infect the urinary tract until some prior impairment of vitality has prepared the soil for them.

**Typhoid Bacillus Infection of the Bladder.** That the typhoid bacillus may be the sole agent in producing chronic cystitis is a recent and clinically important revelation, although the frequent presence of the bacilli in the urine was long ago recorded. Horton Smith<sup>1</sup> finds the bacilli in about 25 per cent. of all cases, usually appearing during the third week of the disease and persisting long after convalescence. Unless very numerous they occasion no suppuration nor vesical irritation, often even no turbidity of the urine.

Gwyn,<sup>2</sup> after extended research, concludes that the bacilli are present in the urine in 20 to 30 per cent. of all cases of typhoid fever, usually in pure culture and often sufficiently numerous to render the urine turbid; they appear during the second or third week and may remain for months, even years; they probably multiply in the bladder, the urine being apparently a good culture medium. They disappear after irrigation of the bladder with sublimate solution, or the internal administration of urotropin. One of Gwyn's cases had had cystitis for four years following an

<sup>1</sup> Lancet, May 20, 1899.

<sup>2</sup> Bulletin of Johns Hopkins Hospital, 1899, p. 109.

attack of typhoid fever ; urine withdrawn from the bladder by aspiration showed a pure culture of the typhoid bacilli. In another case severe cystitis and nephritis occurred in the third week ; urotropin, 30 grains daily, rendered the urine sterile in five days, but after two weeks the bacteria reappeared in considerable numbers, though the urotropin had been continuously administered.

Houston<sup>1</sup> reports a case pregnant with suggestions ; his patient had had cystitis for three years ; the urine was found to give a culture of the Eberth bacillus, and the blood gave the Widal reaction. The unique feature is that the patient had never suffered from typhoid fever so far as could be ascertained.

**Bacteriuria.** The bacterial infection of the urine only, the urinary channels remaining uninfected, is a conception first formulated by Roberts, in 1881, under the name bacteriuria. The correctness of this conception is now amply demonstrated, both by cystoscopic examinations and by autopsies, though the conditions which render the urine a continuously fertile soil for bacteria have not yet been revealed. In none of the reported cases has the urine contained sugar, and in only a few—cases of coincident nephritis or cardiac disease—has albumin been discovered ; the urine is almost invariably acid, and is usually free from pus and other morbid elements.

In most of the cases recorded there has been a complete absence of symptoms, local or general, except the turbidity and feter of the urine ; in some there have been symptoms of vesical irritation (including urinary incontinence, especially in children), and in these the cystoscope has shown congestion of the bladder lining ; in other cases digestive and nervous symptoms have ceased when the urinary infection has been arrested.

The path of infection seems often to have been the urethra, since urethritis, injections, or catheterism have preceded the urinary infection ; in some, however, the absence of these suggests the entrance of the bacteria into the urine from the blood and kidneys, or possibly direct from the rectum. In some cases the entire urinary tract contains infected urine, in others the bladder only.

The arrest of the urinary infection is usually promptly secured by the ingestion of urotropin, 30 to 40 grains daily, or salol, 100 to 150 grains daily ; and it may be hastened by irrigations of the bladder with silver nitrate or sublimate solutions.

Jeanbrau<sup>2</sup> furnishes an elaborate review and bibliography of this subject ; he collected 67 cases from the literature, in 56 of which the infecting agent was found to be the colon bacillus ; in the other cases the

<sup>1</sup> British Medical Journal, 1899, No. 2.

<sup>2</sup> Gazette des Hôpitaux, June 24, 1899.

streptococcus, proteus, and bacillus subtilis were discovered, alone or in combination.

**Treatment.** UROTROPIN. The most valuable agent that we possess for combating infections of the urinary tract was given to us a few years ago by Nicolaier, in urotropin. Reports as to its efficacy have become so numerous as well as so uniform that specific articles from the literature need not be adduced. Its therapeutic efficacy is explained by the statement that when excreted by the kidneys a part of it is decomposed, one of the resulting constituents being formaldehyde. Its uniform effect, however brought about, is to render the urine acid and to arrest the growth of all bacteria infecting the urinary passages, except the tubercle bacillus and the gonococcus; the inflammations induced by bacteria subside, the production of ammonia and of pus ceases, and the cystitis ends. Urotropin thus accomplishes in many cases of cystitis more than all other local and internal treatment has ever before secured; its effects are especially gratifying in the severe and intractable cystitis accompanying prostatic enlargement. Gwyn and Richardson found that the typhoid, like the pyogenic bacteria, disappear from the urine during its internal administration. Urine passed during the ingestion of the drug remains sterile, though exposed to the air for days.

Urotropin is of extreme value to the surgeon also, giving him the ability to secure, before and after operative measures, that ardently sought "asepsis of the urinary tract" hitherto usually unattainable. The drug should be administered for several days before and after every operation upon an infected urinary tract.

Yet this most valuable agent has its limitations; its effect upon bacteria seems to be rather an arrest of growth than destruction, since after its discontinuance the bacteria may reappear and the cystitis recur, even though the remedy has been continued for several weeks; yet its long-continued use may finally cause permanent sterility of the urine. Moreover, in some cases of cystitis with acid urine its use is prohibited by the acidity imparted to the urine, micturition becoming quite painful. In one of my patients, and in one case narrated to me by Dr. Baum, of Chicago, palpitation and pronounced weakness of the heart's action occurred in patients without cardiac disease whenever urotropin was given, ceasing upon its discontinuance; so severe was this effect that the remedy could not be administered.

Aside from these phenomena, there is, so far as I am aware, no contra-indication to the use of urotropin, 20 to 30 grains daily (in capsules or watery solution) in 5 to 10 grain doses. These usually accomplish all that a larger quantity will secure, and they may be continued for weeks without disturbing the functions of any organ in the body.

Although some improvement in tuberculous and gonorrhoeal cystitis

has been reported in a few cases, the consensus of experience, with which my own coincides, is that these infections are not perceptibly improved by urotropin.

Nicolaier's original assertion, that this agent has a pronounced effect in dissolving renal calculi composed of uric acid and its compounds, is unfortunately opposed by the unanimous experience recorded in current literature; possibly the detachment and escape through the ureter of small calculi is facilitated by the subsidence of the swelling in the mucous membrane of the renal pelvis and ureter, consequent upon the arrest of bacterial action and reactive inflammation. Aside from this indirect effect urotropin seems to have no influence upon renal or vesical calculi, whatever their chemical components.

By virtue of its influence in augmenting the acidity of the urine, urotropin favors the solution of the phosphates in that fluid, and hence removes the symptom phosphaturia.

**Direct Treatment of Pyelitis.** The treatment of chronic pyogenic infections of the renal pelvis has been improved by the use of the ureteral catheter. Through this instrument the pelvic mucous membrane has been directly irrigated and drained. (See section of this review on Catheterism of the Ureters.)

## TUBERCULOSIS.

Tuberculosis, as a primary infection of the genito-urinary organs, has begun to receive the attention which its frequency and gravity require. Experience has shown that it is a common cause of "cystitis" in young persons, especially males between fifteen and thirty years of age, even those of robust appearance; that its usual primary site is either the sexual canal (epididymis and seminal vesicle) or the kidney; that the symptoms first observed by the patient suggest cystitis, though the bladder may long remain free from infection.

The diagnosis of tuberculosis affecting surfaces bathed by the urine is rendered absolute by the detection of the specific bacilli in the urinary sediment (to be carefully distinguished from smegma bacilli by thorough washing with alcohol after immersion in the decolorizing acid). This detection has been facilitated by the centrifuge; yet even with this aid the bacilli cannot always be discovered. It is important that in seeking the cause of vesical irritation, tuberculosis be remembered and excluded before the sound or cystoscope is introduced, for the slight traumatism inseparable from the introduction of a rigid instrument through the tuberculous prostate favor extension of this infection, as well as the formidable complication with pyogenic infection, either of which may be marked by chills, fever, and increase of pus and albumin in the urine.

The tuberculin test has not been employed in suspected genito-urinary tuberculosis so extensively or successfully as to establish its value as a diagnostic measure.

**Treatment.** The trend of practice in the treatment of surgical tuberculosis toward constitutional rather than operative measures is favored in genito-urinary tuberculosis by the possibility and practice of early diagnosis; sunshine, dry air, general hygiene, and guaiacol are the most efficient agents in treatment.

In the local and surgical treatment a sharp distinction appears in the success attained between renal and vesical tuberculosis, because the disease is more often primary and limited in the former than in the latter.

The local treatment of vesical tuberculosis has taken many experimental forms: injections of the bladder with air (Raimond) and with iodoform emulsion, suggested by the success of these agents in peritoneal and synovial tuberculosis respectively, have almost uniformly failed to materially improve the vesical infection, though a cure, lasting five years, by injections of 5 per cent. iodoform emulsion in oil of vaseline, after sublimate injections had failed, was reported to the French Association in 1898. Banzet<sup>1</sup> reports 39 cases, 6 completely cured by Guyon's sublimate injections—1:5000 to 1:3000; he ranks guaiacol next in efficiency, while iodoform, lactic acid, and formaldehyde he considers inferior.

Chetwood<sup>2</sup> reports a case of vesical tuberculosis markedly improved by the subcutaneous administration of nuclein for an extended period; Vaughan had previously mentioned two cases improved and one cured by the same remedy applied locally as well as subcutaneously.

The surgical treatment has comprised excision and resection of the bladder, curettage and cautery of the mucous lining. The last-named method cured nine cases reported to the French Urological Association, in 1898, by Clado and Motz.

Excision of the tuberculous seminal vesicle, first practised by Ullmann in 1889, has been extended by Roux into extirpation of the vesicle, vas deferens, and testicle, and has been performed in twenty cases without operative mortality.

Tuberculosis of the kidney offers a more favorable outlook for surgical attack and radical cure through extirpation, since the infection is often primary in and for a time limited to this organ. The frequency with which renal tuberculosis is bilateral—stated by some as 50 to 60 per cent.—and the insidious, symptomless course of the disease, formerly rendered the surgeon reluctant to attack that kidney believed to

<sup>1</sup> *Centralbl. f. d. Gesamte Therapie*, November, 1897.

<sup>2</sup> *Journal of Cutaneous and Genito-Urinary Diseases*, July, 1899.

be tuberculous, since in quite a few recorded instances nephrectomy was promptly followed by uræmia, the autopsy showing undetected but advanced tuberculosis of the remaining organ. This danger has been materially reduced by the ability, acquired in recent years, to catheterize the ureters and thus determine the condition of the opposite kidney before operation. Recent nephrectomies for tuberculosis, after precautionary demonstration of a normal condition of the remaining kidney, have shown a greatly reduced mortality and a large percentage of apparent cures. These later results are better than those collected by Bangs,<sup>1</sup> since his list includes all that could be gathered for the last ten or twelve years. Of the 135 cases of nephrotomy and nephrectomy for renal tuberculosis comprised in Bangs' list, 27 died within a month after operation, 13 in from two to nine months; 45 survived from one to eight years; 31 of those operated on within a year were in good condition. Thus the results were good in 76 and poor in 40 cases, while the remaining 19 were at the time of the report indecisive. Among 91 primary nephrectomies there were 17 deaths (18.7 per cent.); of 22 nephrectomies following nephrotomy, 8 died (36.3 per cent.).

The discussion of Park's<sup>2</sup> paper on this subject by the Association of Genito-Urinary Surgeons, in 1898, showed a disposition to indorse the author in advocating the more frequent removal of tuberculous kidneys; though Bryson warned, from an experience of seven cases, that manipulation of apparently healthy or slightly diseased kidneys was apt to cause rapid extension of the infection, and Reynier reported to the last French Congress three cases of nephrectomy which had been followed by general and rapidly fatal tuberculosis.

Trendelenburg has had a mortality of only 13 per cent. in nephrectomy for tuberculosis, and Lennander only one death in fourteen such cases. In one case which recovered Trendelenburg removed the kidney, ureter, and bladder, stitching the remaining ureter into the sigmoid flexure; and Weir has apparently cured a case by resection of the bladder with subsequent nephrectomy. The best disposition of the tuberculous ureter after nephrectomy is still unsettled; some think complete excision necessary, while others are satisfied to stitch the upper extremity into the skin wound, believing that the ureter thus treated atrophies into a fibrous cord, and the tuberculous infection subsides.

Resection has been substituted for extirpation of the kidney in sixteen cases, mostly tuberculous, collected by Ransohoff,<sup>3</sup> all have recovered from the operation—whether from the disease remains to be seen.

While the surgical treatment of renal tuberculosis is still in the devel-

<sup>1</sup> *Annals of Surgery*, January, 1898.

<sup>2</sup> *Journal of Cutaneous and Genito-Urinary Diseases*.

<sup>3</sup> *Philadelphia Medical Journal*, August 26, 1899.

opmental stage, present experience warrants the belief that in cases where the disease seems limited to one kidney, so far as can be ascertained by catheterism of the opposite ureter, nephrectomy offers a good prospect both of operative recovery and radical cure; and there is a possibility that resection of the kidney will secure equally good results at slight operative risk.

### **ACTINOMYCOSIS.**

Michailoff<sup>1</sup> collects thirteen cases of this rare infection of the genito-urinary organs. It is seldom primary in any of these organs, usually secondary to infections of the alimentary canal (especially the rectum), or of the blood; ascending infection by the ureter has not been observed.

The author reports a unique case from Poncet's clinic: A man had several months before introduced some straws of grain into the urethra; calculi formed in the bladder and were crushed, but finally there was removed by cystotomy a phosphatic calculus enclosing actinomycetes.

### **HÆMATURIA.**

The admixture of blood with the urine is a frequent symptom of disease of the urinary tract which terrifies the patient and disturbs the physician. Until the introduction of the modern cystoscope, in 1886, the detection of the cause and source of the bleeding was often beyond the power of the most expert urologist. Cystoscopy, however, by affording direct inspection of the interior of the bladder, as well as of the ureteral orifices, reveals at once the source of and reason for hemorrhage from the vesical mucous membrane, or discovers the exit of urine from one or the other ureter. Fourteen years' work with the cystoscope has disclosed several causes for vesical hemorrhage in addition to cancer and calculus; it has shown papillomata, non-specific ulcers, varicose veins (bladder hemorrhoids), encysted calculi, bleeding from septic and tuberculous infections, and bleeding of the mucous membranes without local excitant, ascribed to the gouty and other constitutional conditions resulting in arterio-sclerosis, fatty and amyloid degeneration of the vesical lining.

**Essential Renal Hæmaturia.** Renal calculus, tuberculosis, and cancer—known causes of hemorrhage—have been absent in many cases of chronic bleeding, even severe, from the kidneys. These cases have been labelled among surgeons "essential," or symptomless renal hæmaturia, or, even more grotesquely, as "bleeding from healthy kidneys" (Klemperer), or "renal hæmophilia" (Senator). These terms, admittedly

<sup>1</sup> Thèse de Lyon; Gazette des Hôpitaux, 1899, 70.



indicative of ignorance as to the true pathology, have been greatly restricted in their application by recent observations, which explain the hemorrhage in many cases formerly tabulated under these mysterious names.

With certain exceptions we can in no case consider a chronic hemorrhage to be of renal origin unless such origin is proven either by cystoscopy, ureteral catheterism, or by operations upon the kidney. Signs and symptoms however admissible as evidence before the possibility of direct proof was acquired cannot now be accepted, since our present means of diagnosis show symptomless bleeding from the bladder also. Thus, Frank<sup>1</sup> reports a case of hæmaturia in a woman due to plastering of the bladder wall with uric acid crystals; the removal of these by the Bigelow evacuator was followed by a cessation of hemorrhage, maintained during the two years of subsequent observation. Picqué arrested a hemorrhage from the displaced kidney of a woman by nephrotomy and resection of a serous cyst. Three years later hæmaturia recurred; not, as might have been assumed, from the kidney, but, as the cystoscope showed, from a vesical tumor, the removal of which arrested the hemorrhage.

The constitutional conditions which may be admitted on general clinical experience, without ocular proof of the renal source, as causes of symptomless renal hæmaturia, are malaria, scurvy, purpura, and hæmophilia; acute blood infections, such as scarlet and typhoid fever; vicarious menstruation and excessive muscular effort. These conditions are usually obvious and the hæmaturia transient. (It is noteworthy that renal bleeding from malarial infection, usually refractory to quinine, is often promptly arrested by turpentine.)

There remain many cases of renal bleeding in which these causes, as well as cancer, calculus, and tuberculosis of the kidney, have been excluded. I have been able to collect from the literature 55 cases in which the renal source of the bleeding was proved by the cystoscope, ureteral catheter, or operation; and I have myself observed four unpublished instances. In 56 of these 59 cases the offending kidney had been examined: in 18 after nephrectomy, in 28 by nephrotomy, in 3 by simple exposure with acupuncture, in 7 for nephrorrhaphy. Of the 18 kidneys excised there was recognized in 7 the picture of chronic nephritis, which is therefore regarded as one of the causes of symptomless or "essential" renal hæmaturia. It is noteworthy that the urine passed after recovery in three of these cases is reported as free not only from blood, but also from every other indication of disease; whence the inference is drawn that nephritis may be unilateral. In three other cases it is stated that the excised kidney presented no gross or microscopical evidence of

<sup>1</sup> *Medicine*, April, 1899.

disease; yet so far as the reports go, the alleged healthy kidneys may have been the subjects of undue mobility or congestion—conditions which are now known to be causes of renal hæmaturia. In each of the two cases reported by Pinner<sup>1</sup> and Poinier,<sup>2</sup> nephrotomy had been made without arrest of hemorrhage before nephrectomy was performed; since the other known causes of renal bleeding must have been relieved by the nephrotomy, it is fair to assume that the chronic nephritis, evident in the excised kidneys, was the cause.

Of the remaining eight kidneys excised for hæmaturia, three (Reynier's cases) were found to be tuberculous, and two were pronounced by Israel to be the seat of chronic syphilitic nephritis; while in Routier's<sup>3</sup> case the extirpated kidney seemed quite normal until a very close scrutiny revealed at the apex of a papilla an eroded arteriole in a minute tuberculous ulcer. In McBurney's<sup>4</sup> case the apparently healthy organ was found microscopically by Delafield to exhibit hemorrhagic pyelitis. In Myles's<sup>5</sup> case nephrectomy, made three weeks after unsuccessful nephrotomy, showed a similar condition of the pelvis, reported as "myxangioma." The 18 nephrectomies have therefore revealed, as the cause of the hæmaturia, chronic nephritis in 7, tuberculosis in 4, syphilis in 2, hemorrhagic pyelitis in 2, while in 3 no lesion was discovered. The eleven patients who recovered from the operation were free from hæmaturia (Poinier's case died three months later of chronic nephritis).

In 30 cases of renal hæmaturia an exploratory nephrotomy has been made; in 3 of these (above mentioned) the continuance of the bleeding was followed by nephrectomy. In 5 others there followed a temporary arrest, with subsequent recurrence of the bleeding; 1 died from the operation; in the remaining 21 cases the hemorrhage ceased permanently so far as the reporters ascertained. (It may be mentioned that in two cases not included in this list, nephrotomy revealed early tuberculosis of the kidney, but was followed by prolonged arrest of bleeding.) Hence, simple nephrotomy has cured hæmaturia in 75 per cent. of surviving cases, with a mortality of less than 4 per cent. In the seven cases in which it failed there were subsequently found chronic nephritis in 3 (by nephrectomy), tuberculosis in 3, and in 2 the cause was not discovered. In the 21 cases of nephrotomy, followed by permanent arrest of bleeding, an explanation of the success is offered in only one case (Debaisieux's),<sup>6</sup> where two small semi-transparent projections of the mucous membrane of the renal pelvis were found and removed.

<sup>1</sup> Archiv f. klin. Chirurgie, 1898, p. 447.

<sup>2</sup> Annales d. Mal. d. Organe Genito-Urinaire, 1899, p. 64.

<sup>3</sup> Annales de la Soc. de Chirurgie, June, 1898.

<sup>4</sup> Annals of Surgery, 1898.

<sup>5</sup> Medical Press and Circular, August 23, 1899.

<sup>6</sup> Annales de la Soc. belge de Chirurgie, January, 1898.

Other operative measures have been followed in single cases by equally good results ; simple exposure of the kidney, with or without puncture, has in three out of four cases been followed by permanent arrest of hemorrhage ; in the fourth case the failure was followed two years later by nephrectomy and death, at which time the kidney was found to be chronically inflamed. Again, exposure and fixation of a movable kidney has been followed by a permanent cure of hæmaturia in seven cases (Albaran, Newman, and Israel) ; in one of these, of four years' standing, Newman<sup>1</sup> found the kidney rotated, the pedicle twisted, and a kinking of the ureter over the renal vessels. In Passet's<sup>2</sup> curious case the bleeding in a middle-aged woman was believed to proceed from the bladder ; the injection of a silver nitrate solution was followed by immediate arrest of hemorrhage, the urine remaining normal for eighteen months ; then severe bleeding recurred. The bladder was opened and the ureters catheterized, showing that the blood flowed from the right kidney ; the intended nephrectomy was deferred because of the patient's condition, but no further bleeding occurred for two years, when slight hæmaturia was observed for two days.

That syphilis might cause renal bleeding seems plausible, because this infection is known to produce chronic nephritis. The direct proof is, however, still lacking, because there is no histological structure peculiar to syphilis. In two cases in which the kidney was excised for hæmaturia, Israel was satisfied that certain changes in the organ were syphilitic ; but the proof seems insufficient. Greene<sup>3</sup> mentions a case of hæmaturia in which nephrotomy was made for suspected renal calculus, but none was found, and the bleeding continued. Scrapings taken from the renal pelvis were pronounced by a pathologist to be suggestive of malignancy. Mercurial inunctions were given and in two weeks the bleeding stopped ; then the treatment was discontinued and the bleeding recurred ; inunctions were resumed and the bleeding stopped permanently. In an unpublished case of my own, serious bleeding, shown by the cystoscope to issue from the right kidney, persisted for several weeks in spite of turpentine, cantharides, and other remedies. A clear history of syphilis led to the administration of the iodides ; ten days after this treatment was begun the bleeding stopped permanently. Such observations as Greene's and my own are, however, suggestive rather than conclusive as to the agency of syphilis in provoking renal hæmaturia.

There remain cases in which the bleeding ceases without medication, or after treatment which has no perceptible relation to the kidney. Thus

<sup>1</sup> Transactions of London Clinical Society, vol. xxx.

<sup>2</sup> Centralbl. f. Krankheiten d. Harn. u. Sexuale Organ, 1894.

<sup>3</sup> Journal of Cutaneous and Genito-Urinary Diseases, 1898, p. 590.

Guyon<sup>1</sup> mentions a case in which hæmaturia occurred during each of two pregnancies, and persisted severely for three months after the last confinement, but ceased immediately upon the removal of the child from the breast. A suspicion of malignancy led to a subsequent exploratory nephrotomy, which revealed nothing abnormal.

If we consider the cases which experienced clinicians have pronounced renal hæmaturia from the symptoms, without the ocular proof now demanded—and doubtless in many of these the diagnosis was correct—we find a great diversity in apparent therapeutic successes as well as in clinical history. One of the frequent features is the intermission of the bleeding, often for long periods; thus Oliver<sup>2</sup> observed a gentleman, forty-six years old, who had had severe bleeding five times at intervals of five years—probably from chronic nephritis, since his urine contained granular casts. Another frequent accompaniment of renal hæmaturia is pain over the kidney, often extending along the course of the ureter into the testicle, and sometimes amounting to severe renal colic. This with the bleeding has often led to the diagnosis of renal calculus and nephrotomy, the surgeon being doubly surprised by the failure to find the stone and by the complete cure of his patient. In many cases of intermittent hæmaturia the bleeding and nephralgia have been synchronous, though either may be present without the other.

Symptomless renal bleeding seems to have been arrested in individual cases by widely diverse therapeutic agents: the recumbent posture, cold baths, vapor baths, massage, cantharides, turpentine, quinine, mercurials, etc.; yet each of these has usually failed, though not as might be supposed because of diversity in the cause; in Oliver's case the first hemorrhage, which persisted in spite of several remedies, ceased soon after quinine was administered, the result being ascribed to that drug; upon the second attack quinine was at once given, but without affecting the hemorrhage, which finally stopped when the patient was confined to his bed—the cessation being this time ascribed to rest. During a subsequent bleeding the patient was compelled to lead an active out-door life, but the attack lasted no longer than the earlier ones. In this case the urine contained granular casts.

A critical examination of all available sources of information shows the following causes for "essential" renal hæmaturia:

1. Chronic nephritis.
2. Congestion of the kidney, from either hæmic irritants or mechanical causes (movable kidney, tight lacing, etc.).
3. Incipient tuberculosis.

<sup>1</sup> *Annales d. Mal. d. Organe Genito-Urinaire*, 1897, p. 113.

<sup>2</sup> *International Clinics*, October, 1895.

4. Renal retention in hydronephrosis, the vesical distention following prostatic enlargement, etc.

5. Bacterial infection of the renal pelvis, as in hemorrhagic pyelitis.

Foremost among these causes of symptomless hæmaturia stands chronic nephritis. It is noteworthy that of the eighteen kidneys excised to arrest bleeding only three have been considered healthy, and two of these—among the earliest cases—were not critically examined; indeed, in only one (Klemperer's<sup>1</sup>) is there good reason for assuming the absence of nephritis. Floderus<sup>2</sup> reports that a kidney excised for hæmaturia by Lennander appeared macroscopically healthy, but was found by the microscope to present extensive glomerulitis with some fatty degeneration. In many of the cases in which renal bleeding has been arrested by nephrotomy the macroscopical evidences of nephritis have been noted by the operator; in Oliver's case the bleeding kidney is described as only one-sixth the normal size. Israel<sup>3</sup> and Körte excised pieces of the kidney in such cases, and usually found evidences of nephritis.

The arrest of hemorrhage by nephrotomy, acupuncture, and splitting of the fibrous capsule strongly suggests that the bleeding was caused by congestion of the kidneys. This suggestion receives corroboration from the effect of splitting the fibrous capsule, or nephrotomy, in diseased conditions of the kidney unaccompanied by hæmaturia; thus Harrison observed the albuminuria of subacute infectious nephritis cease in three cases after simple splitting of the capsule of one kidney; and there are two notable cases recorded (by Israel<sup>4</sup> and Nélaton<sup>5</sup>) in which anuria, occurring in a patient from whom one kidney had been previously removed, was promptly relieved by simple incision of the remaining kidney. As no stone or other mechanical cause for the anuria was found, as the kidney was greatly congested, and as the renal secretion was promptly resumed after the nephrotomy in each case, the arrest of secretion was ascribed by each operator to the congestion present, and the resumption of secretion plausibly explained by the relief of this congestion through splitting of the capsule. Certain observations of transient hæmaturia in non-operative cases also suggest renal congestion as the cause; thus Hutchinson<sup>6</sup> observed repeated hæmaturia with Raynaud's phenomena in the same patient after exposure to cold.

Incipient tuberculosis in apparently healthy persons is certainly the explanation of renal hæmaturia in many cases. The unusual resistance of the kidney-tissue to this infection renders its progress slow, even intermittent—phenomena well illustrated in a case observed by Newman,<sup>7</sup> in

<sup>1</sup> Deutsche med. Wochenschrift, 1897, 9 and 10.

<sup>2</sup> Centralbl. f. Chirurgie, 1899, No. 34.

<sup>4</sup> Loc. cit.

<sup>6</sup> Archives of Surgery, vol. ix. p. 88.

<sup>3</sup> Ibid., 1899, No. 31.

<sup>5</sup> Gazette des Hôpitaux, 1899, No. 62.

<sup>7</sup> Lancet, August 26, 1899.

which "essential" renal hæmaturia had occurred thirteen years and again four years before evidences of renal tuberculosis became decisive.

There remain a few cases which with our present knowledge do not seem to be plausibly explained in any of these ways; they may still be called "angioneurotic" hæmaturia until the future brings elucidation.

**Treatment.** The treatment of symptomless renal hæmaturia must begin with a determination of the cause. The constitutional conditions mentioned having been eliminated, there remain four chief local causes: nephritis, congestion, incipient tuberculosis, and septic infection. The medical treatment of bleeding from these causes is tentative, and should include the recumbent posture and saline aperients; among drugs, cantharides, turpentine, camphoric acid, and urotropin are worthy of trial.

If such measures fail and the loss of blood becomes dangerous, surgical interference is imperative. Of the various operative measures, nephrotomy, which has cured twenty out of twenty-six non-tuberculous cases, and permits digital exploration of the pelvis and involves but little danger, is clearly the choice; in but few cases can the more dangerous nephrectomy be subsequently required.

### NEPHRALGIA.

This symptom, formerly the subject of much speculation, is now regarded as is essential hæmaturia, as a sign of renal disease or of tension of the renal capsule by congestion of that organ. Many of the cases of so-called essential renal hæmaturia have been accompanied by nephralgia; and, conversely, many in which the first and chief symptom was pain in the kidney have developed hæmaturia.

The intimate association of the two is further confirmed by the curative effect of exposing and incising the kidney, which has promptly relieved nearly all reported cases, even when no local lesion was detected by the operator. Hubbard<sup>1</sup> collects from the literature 26 cases of nephralgia (several accompanied by hæmaturia) which were cured by operation—nephrotomy in 9 cases, exposure and acupuncture in 6, splitting of capsule in 5, nephrorrhaphy in 3, operation not specified in the remaining 3. He adds 5 cases from the records of the Massachusetts General Hospital—2 cured by nephrotomy and 1 by palpation, while 2 others were only improved by nephrotomy (one passed gravel afterward). While the symptom nephralgia may thus be catalogued with the symptom renal hæmaturia, as usually indicating local lesion in the kidney, yet the possibility that pain in the lumbar region may result from a remote

<sup>1</sup> *Annals of Surgery*, August, 1899.

disease should not be forgotten ; for Péan<sup>1</sup> excised a healthy kidney to furnish relief from severe pain, which, however, persisted, and was subsequently discovered to be caused by incipient tabes.

### RENAL INSUFFICIENCY (RENAL PERMEABILITY).

The detection of imperfect renal excretion has obvious importance, especially to the surgeon who contemplates an operation on the urinary organs or general anæsthesia for any purpose ; operations upon the kidney impose an especially imperative obligation to determine the excretory activity of its fellow. Numerous attempts have been made to detect renal insufficiency by methods less cumbersome, laborious, and inaccurate than the analysis of the urine. Two recent methods, which approach the subject from radically different points of departure, require review : these are first, by the determination of the excretion of aniline dyes, notably methylene-blue ; and second, by the determination of the freezing-point of the blood—in the subject of renal disease.

The excretion of methylene-blue has been the object of numerous observations since Achard and Castaigne<sup>2</sup> published their first article. Their method consists in the subcutaneous injection of 1 c.c. of a sterilized 5 per cent. solution of the blue ; as this is rapidly absorbed and excreted by normal kidneys, the urine is collected every half hour after the injection is made until the end of elimination. In certain diseased conditions of the kidney the excretion of the blue is retarded and protracted ; in a few cases it has failed to appear in the urine, at least in recognizable form.

Unfortunately the workings of this simple test have been neither uniform nor certain. Bard<sup>3</sup> found that renal permeability to the dye was generally decreased in interstitial, but increased in parenchymatous nephritis ; while in the kidneys that had undergone secondary contraction there was observed no difference from the normal excretion. Bazy<sup>4</sup> maintains that delay and failure to eliminate the blue should warn against operation, and mentions<sup>5</sup> two cases of dubious renal integrity in which the prompt elimination of the dye encouraged him to operate, and with successful result.

Albarran and Bernard<sup>6</sup> report an elaborate study of this subject in twenty-four cases of various renal diseases. They urge that the ureteral catheter must be used for this test, because the frequent existence of

<sup>1</sup> Quoted by Leguen. *Annales d. Mal. d. Organe Genito-Urinaire*, 1891, p. 564.

<sup>2</sup> *Soc. médical des Hôpitaux*, April 30, 1897.

<sup>3</sup> *La Presse Médicale*, 1897.

<sup>4</sup> *Annales de Gyn. et de Chir. Abdom.*, April, 1897.

<sup>5</sup> *Annales d. Mal. d. Organe Genito-Urinaire*, June, 1899.

<sup>6</sup> *Ibid.*, April and May, 1898.

renal retention delays the arrival of the blue urine in the bladder an appreciable interval after its excretion; their examinations were made with this precautionary measure. They do not find any definite and constant ratio between renal diseases, individual or collective, and the excretion of methylene-blue, though they note that in a case of renal tuberculosis there was no excretion whatever, while in one of renal epithelioma the excretion was made as soon by the diseased as by the healthy kidney.

Mavrojanis<sup>1</sup> saw the blue appear in the urine forty to fifty minutes after injection, and elimination cease in twenty-four to forty-eight hours in cases of subacute nephritis—as permeable as normal kidneys.

Nesti,<sup>2</sup> having carefully observed the elimination of the blue in twelve cases—six with normal renal function and six of nephritis—concludes that the test has absolutely no value.

These and other observations indicate that the elimination of this dye bears no constant nor uniform ratio to morbid conditions of the kidney, and Lépine reports results equally uncertain from the use of rosaniline trisulphonate of sodium, which he had substituted for methylene-blue, because it is not decomposed in passing through the body, and is, moreover, not toxic. Yet a definite ratio between kidney disease and permeability to one of these dyes—had such been established—would still have only a dubious practical value, since it is not proven that permeability to methylene-blue is identical with or parallel to the excretion of the natural products of tissue-waste or of the toxins of disease. Achard has recently suggested (to overcome this objection) the use of phloridzin, which causes healthy kidneys to excrete sugar, and might possibly be found inactive in diseased kidneys; as yet, however, no data have been furnished in this direction.

It seems probable that a more accurate though less convenient method for detecting renal insufficiency has been evolved by Koranyi<sup>3</sup> from the variations of the freezing-point of the blood or its serum. He has merely applied to the blood the well-established physical principle that the freezing-point of a liquid sinks as the number of molecules in a given bulk of that liquid increases; thus the coagulation of water containing some mineral substance in solution is lower than that of distilled water. He found that the same general principle applied to water in which albuminous, saccharine, and mineral substances are dissolved—i. e., the blood. By many observations he established the fact that the freezing-point of blood from individuals with normal kidneys presents but slight variations, ranging from 0.56° to 0.58° C. below that of distilled water.

<sup>1</sup> *Comptes Rend.*, 1898, p. 263.

<sup>2</sup> Abstract in *Annales d. Mal. d. Organe Genito-Urinaire*, January, 1899.

<sup>3</sup> *Zeitschrift f. klinische Médecin*, Bd. xxxiii.



The blood of those whose diseased kidneys fail to excrete normally should exhibit a lower freezing-point, because it contains excrementitious as well as the usual ingredients ; and this lowering of the freezing-point Koranyi actually found in cases of nephritis, hydronephrosis, pyonephrosis, and kidney tumors. He also found that sinking of the freezing-point was brought about by insufficient breathing ; but that this error could be corrected by passing oxygen through the blood in a glass before freezing.

This work has been supplemented by the experimental researches of Richter and Roth.<sup>1</sup> They found that double nephrectomy on animals causes within twenty-four hours a decided lowering of the freezing-point of the blood, while extirpation of one kidney had no such effect unless the remaining kidney was injured, when the same result followed. They induced glomerulo-nephritis in rabbits by the subcutaneous administration of cantharidin, and noted that the freezing-point of the animals' blood fell from  $0.56^{\circ}$  or  $0.58^{\circ}$  to  $0.63^{\circ}$  C. within twenty-four hours ; while after larger doses the freezing-point was lowered to  $0.70^{\circ}$  and  $0.72^{\circ}$  C. The size of the dose administered bore a distinct parallel with the extent of the inflammation, the sinking of the freezing-point, and the degree of renal insufficiency ; while the percentage of albumin in the urine presented no such constant ratio.

The increase in the molecules dissolved in the blood might be ascribed to the salts therein contained or to organic constituents. To decide this question, Richter and Roth determined the percentage of sodium chloride in the blood before and after nephritis was induced by various agents ; they found that it was never much increased, often unchanged, and sometimes diminished in the blood whose freezing temperature was distinctly lowered. Since sodium chloride constitutes the greater part of the inorganic salts of the blood, and since its behavior may be accepted as that of the other metallic compounds, they infer that the augmentation of molecules indicated by the reduction of the freezing-point must be organic, and, under these circumstances, excrementitious. In a later article Koranyi<sup>2</sup> shows that curare defers both the sinking of the freezing-point of the blood and the death of the animal after double nephrectomy in rabbits, and promises the report of observations on the human subject.

The application of Koranyi's method to medical cases seems limited, for the results are found to be less uniform in cases where dropsy or anæmia is present, or during severe renal pain or colic, or in the presence of large renal tumors ; yet the confirmation of his work will give the surgeon a much-needed means for estimating the safety of operations on the kidney.

<sup>1</sup> Berliner klinische Wochenschrift, August 31, 1899.

<sup>2</sup> Ibid., 1899, No. 36.

**THE DETECTION OF URINARY CALCULI BY RÖNTGEN RAYS.**

The X-ray has been found distinctly serviceable in the detection of urinary and prostatic calculi ; it has also been used in determining the existence of a second kidney before operation on its fellow, but the cystoscope and ureteral catheter furnish information on that subject which is obviously more satisfactory.

The Röntgen ray, properly directed, will clearly picture even very small stones if they are composed in large part of the oxalates, carbonates, or phosphates ; while calculi of uric acid or its compounds are less certainly detected when of small size.

It has been further shown, notably by Abbe,<sup>1</sup> that many small and thin stones which escape detection by long exposure (fifteen minutes or more) are distinctly revealed by short, even one-minute, exposures. He found that a calculus only one-eighth of an inch across, enclosed in a kidney and a layer of beefsteak, was distinctly pictured by a short exposure ; and in two cases he detected by the X-ray and removed from the kidney a small calculus whose greatest dimension did not exceed one-half inch ; one of these was of irregular, triangular shape, and presented only 3 mm. of thickness for the interception of the rays. These stones were, however, composed wholly or in part of oxalates, the least permeable of urinary concretions to the X-ray. The successful pictures were taken with a one-minute exposure, the distance between the tube and plate being twenty inches. Braatz<sup>2</sup> reported to the last Congress of German Surgeons similar experiences with small calculi, as a result of which he also extols the value of very brief exposures. Fenwick<sup>3</sup> has seen by the fluoroscope introduced into the wound a stone one-half inch in diameter ; Abbe discards this aid.

**Renal Calculi.** Abbe collects from the literature twenty-five cases in which the picture of renal calculus by the X-ray has been verified by operation and extraction ; and he adds two from his own experience. I have noticed reports of four other cases, published too late for inclusion in his article ; there are, therefore, thirty-one cases of this kind now on record.

The diagnosis of renal calculus has heretofore been a deduction from symptoms, and not a demonstration ; the frequent impossibility of distinguishing, prior to operation, a kidney stone from cancer or tuberculosis of the kidney, and from essential renal hæmaturia, has been generally recognized ; so expert a surgeon as Henry Morris has incised the kidney over forty times for differential diagnosis without finding the calculus whose existence seemed indicated by the symptoms.

<sup>1</sup> *Annals of Surgery*, August, 1899.

<sup>2</sup> *Centralbl. f. Chirurgie*, 1899, No. 27.

<sup>3</sup> *British Medical Journal*, 1897, p. 1075.

Alsberg<sup>1</sup> reports the case of a man who had suffered pain in the region of the right kidney for ten years, but had never had renal colic nor hemorrhages; physical examination was negative, and the urine normal to chemical and microscopical tests. The Röntgen ray showed two calculi, which were removed by nephrotomy. Taylor<sup>2</sup> made a nephrotomy for suspected stone, but found none. A week later the X-ray showed a distinct shadow in the upper part of the kidney; whereupon the wound was reopened, the twelfth rib resected, and a stone weighing half an ounce discovered in a cyst-like cavity and removed. In Morton's<sup>3</sup> case symptoms of renal calculi were followed by the spontaneous passage of a stone. The X-ray showed remaining in the kidney a second calculus, which upon removal was found to be composed of oxalates, and to measure three-quarters by one-half inch. In each of Abbe's cases the stone was small and more or less completely encysted; that of the second case was, indeed, so thoroughly surrounded by renal tissue that he would have assumed its absence and abandoned the search had he not had the positive evidence of its presence in the radiograph.

It is evident, therefore, that an X-ray exploration should be made in every case of suspected renal calculus, since the pictures thus secured may enable the operator to detect and remove calculi that escape digital exploration of the renal pelvis, as in Taylor's and Abbe's cases above mentioned; and there are many cases, some recorded, in which the operator has removed only a part of the calculi present, those remaining being discovered by a subsequent operation. Indeed, we may go a step further, and advise that a radiograph be taken prior to any exploration of the kidney, even when some morbid condition of that organ, other than calculus, is recognized by physical examination; for renal calculus is a not infrequent complication of pyonephrosis, tuberculosis, and tumor of the kidney, and has been overlooked in the presence of the latter conditions. Thus, Ransohoff,<sup>4</sup> exploring a kidney, found extensive malignant disease; the autopsy showed also a large undetected calculus. Moreover, caution dictates the radiography of both kidneys prior to operation, since calculi and advanced destruction of a kidney may exist with symptoms slighter than those which attract attention to its fellow.

**Ureteral Calculus.** The detection of calculi in the ureter is surrounded with all the difficulties pertaining to renal calculi and with some others arising from the anatomical relations of the ureter. While palpation of this tube from end to end has been repeatedly practised, it is possible only through an incision of such extent as to make the operation severe as a merely diagnostic measure; the same objection applies to the

<sup>1</sup> Münchener medicinische Wochenschrift, 1898, No. 51.

<sup>2</sup> British Medical Journal, 1898, p. 1126.

<sup>3</sup> Lancet, 1898, p. 1354.

<sup>4</sup> Loc. cit.

sounding of the ureter from the renal pelvis. Catheterism of the ureter from the bladder is a valuable but not universally practicable means of search for ureteral calculi.

Herein lies a broad field for the diagnostic aid of the Röntgen ray; but as yet only limited success has attended the efforts to explore this territory. The obvious reason is that the pelvic bones prevent the transmission of the rays through the body enclosing the lower part of the ureter, in which part calculi commonly lodge. Thus Doyen<sup>1</sup> detected by means of the X-ray a stone in the ureter near the pelvis, but failed to discover by the same means three other calculi located in the lower portion of this canal, though these were detected by the ureteral sound and extracted. It has been suggested that the entire pelvic portions of the ureters can be pictured by radiography if small elongated plates covered with water-proof material be introduced into the rectum, and so inclined as to present the proper angle to the course of the rays proceeding through the ureter. I am not aware that the practicability of this suggestion has been demonstrated on the living subject.

**Vesical Calculi.** Though the detection of bladder stones is generally practicable by the sound or cystoscope, yet some encysted calculi elude both these instruments. The frequency with which vesical stones escape detection has been painfully emphasized in late years by the cases (mostly unreported) in which double castration has been performed for the relief of a cystitis ascribed to prostatic enlargement, but subsequently found to be caused by calculi. While the failure to detect the stones has been due in the majority of these cases to simple neglect to use the recognized means of diagnosis, yet there are instances, by no means rare, in which the sound has failed to find a calculus subsequently revealed to the exploring finger. Thus, Clarke<sup>2</sup> reports twenty-seven cases of encysted calculi, twenty-one from his own experience, some of which could be found only after the finger had been introduced into the bladder (only one of these had been castrated).

**Prostatic Calculi** arrested the Röntgen rays in a case reported by Bird.<sup>3</sup> He removed over 130 such concretions by the incision for lateral lithotomy without opening the bladder, having first located them by a radiogram, which is reproduced in his article.

### **CATHETERISM OF THE URETERS.**

The collection of the urine direct from one kidney, thus preventing the admixture both of the urine from its fellow and of the products of the bladder, is a problem that has engaged the attention of many inves-

<sup>1</sup> Bulletin de l'Acad. de Méd., June 7, 1897.

<sup>2</sup> British Medical Journal, 1898, p. 1141.

<sup>3</sup> Ibid., 1898, No. 30.

tigators ; it has finally been solved for the female, and in many cases for the male, by catheterism of the ureters. This was long ago accomplished in some cases in the female by Grünfeld with the endoscope ; and in 1880, Pawlik, by placing the patient in the knee-chest position and guiding the ureteral catheter by digital and ocular control in the vagina, succeeded in introducing the catheter into the ureter in many women. Neither of these methods, however, was practicable by the average imitator ; indeed, each frequently failed in the practised hands of its inventor.

Kelly<sup>1</sup> developed a method which has secured wide adoption in this country ; its essential features are the knee-chest position of the patient and the introduction of a large, open endoscope through the urethra, whereupon the bladder is partly distended by atmospheric pressure. The operator, reflecting a brilliant light through the endoscope, sees the interior of the bladder, and by the eye guides a fine catheter into the orifice of the ureter. This method has succeeded in the female only ; the attempt by Kelly and others to use it in the male has failed ; and it must be admitted that even experienced operators have sometimes failed to discover the ureteral orifices in the female also. While not universally applicable, it is, nevertheless, a valuable method, requiring no anæsthesia of the patient, no expensive instruments, nor extreme skill on the part of the operator.

The cystoscope, long used in watching the flow of urine from the ureters, has in recent years been successfully fitted with an attachment for introducing a catheter by ocular guidance into these orifices. Catheterizing cystoscopes have been devised by Casper, Nitze, Albarran, de Rocher, and Brenner, differing merely in details of construction. These instruments enable a practised hand to catheterize the ureter usually in the female, often in the male ; it is a process requiring considerable practice by the operator, who must be prepared for failure in any given case. The catheter, once made to enter the ureter, can be usually passed upward to the kidney itself.

Some of the advantages of catheterism of the ureter and of the renal pelvis are sufficiently obvious : by this measure—and by no other—the operator positively knows that the urine flowing from the catheter contains no elements from the other kidney or from the bladder ; he can thus fairly determine the functioning capacity of each kidney and the presence or absence of functional change in it. But the resources of the procedure are not exhausted here ; for strictures of the ureter have been detected and dilated ; calculi in the ureter and in the renal pelvis discovered ; pyelitis treated by irrigation and drainage ; the fluid of hydronephrosis and pyonephrosis drained off. It must be admitted that some of

<sup>1</sup> Twentieth Century Practice, vol. i.

these are exceptional rather than routine procedures ; but merely because of the limitations in the skill of operators.

The most promising of these procedures is the direct local treatment of the diseased kidney pelvis which has been carried out with especial success by the French school. Renal retentions have been repeatedly drained by the ureteral catheter, which has sometimes been retained for days ; Albarran reported to the French Association in 1898 six cases of hydro-nephrosis apparently cured in this way, and advises that this method be always tried. Irrigation of the infected mucous membrane of pyelitis has been followed by distinct improvement, even positive cure, in many cases ; in short, the many advantages of vesical catheterism have been extended to the upper urinary channels.

Calculi in the ureter and pelvis have been repeatedly detected by Casper, Albarran, Kelly and others, and an attempt made to facilitate their egress from the ureter by the injection into that canal of oil, with no striking success.

The diagnosis of abdominal tumors has been advanced by the ureteral catheter. Casper<sup>1</sup> records a case in which a supposed echinococcus cyst of the liver disappeared when the renal pelvis was catheterized, and the fluid of a pyonephrosis escaped through the instrument ; Pawlik and Albarran had similar experiences. Kelly<sup>2</sup> uses the colicky pain in the lumbar region, produced by a distention of the renal pelvis with injected fluid, as a means for locating the kidney, and narrates the following instance : An abdominal swelling was regarded by several consultants as a large floating kidney ; injection of water into the ureter caused pain, which the patient persistently referred not to the tumor but to the lumbar region. The inference that the kidney occupied its normal position and not that of the tumor was confirmed by laparotomy, which revealed the tumor as a distended gall-bladder.

The withdrawal of urine directly from the renal pelvis has corroborated the conclusion, based upon certain nephrectomies for renal hæmaturia, that nephritis may be unilateral, one kidney furnishing albuminous urine containing casts, while that from its fellow is normal. It has also established the correctness of Guyon's teaching as to renal retentions—the decrease in the solid constituents of the urine in the upper passages following obstruction to urinary exit through the lower channels, such as prostatic enlargement. Casper claims to have found tubercle bacilli in urine drawn from the renal pelvis when none were discoverable in the bladder urine, explaining the paradox by the scattering of the bacilli through a larger bulk of urine in the bladder (perhaps a better reason is

<sup>1</sup> British Medical Journal, 1898, p. 1413.

<sup>2</sup> Bulletin of Johns Hopkins Hospital, June, 1899.

the morphological change which the bacilli may undergo in acid urine, as noted by Coplin<sup>1</sup>).

The objections to the practice of ureteral catheterism are two: the danger of carrying infection to the upper urinary passages and the possibility of injuring the ureter. Experience has shown that these theoretical dangers are in practice avoidable; they are indeed comparable to similar objections that might be urged against the ordinary catheterism of the bladder. We well know that the healthy bladder cannot be septicly infected by an unclean instrument; yet since it is the diseased rather than the healthy ureter which needs catheterizing, the same aseptic care and gentle manipulation which have become routine measures in instrumentation of the bladder should be and are practised in catheterism of the ureters. Casper and Albarran report hundreds of cases in which this measure has been executed without appreciable damage of any kind; many of them were pyelonephritis treated by irrigation and drainage, with cure or improvement in most. Pasteau<sup>2</sup> has seen only one infection in 140 cases, mostly out-patients; Reynes<sup>3</sup> has allowed the ureteral catheter to remain in position three days without infection. Yet the possibility of infection of the upper urinary tract, when due precautions are neglected, cannot be denied, and careful efforts at asepsis, gentleness of manipulation, and the avoidance of instrumentation in cases where tuberculosis or acute septic infection of the bladder is known to exist, are principles not to be violated.

Catheterism of the ureters is evidently a most valuable advance in the diagnosis, and probably in the treatment of disease of the renal pelves and ureters; its exact limitations are yet to be determined.

ISOLATION OF THE SECRETIONS OF THE RESPECTIVE KIDNEYS, often attempted before the practice of ureteral catheterism, has been recently again essayed by Neumann<sup>4</sup> and Harris.<sup>5</sup> Each attempts to prevent the admixture of the two urines by constructing a longitudinal partition in the bladder, thus dividing this organ into two cavities, each of which contains the orifice of a ureter. Neumann's instrument contains a partition piece which is protruded into the vesical cavity and pressed firmly against the posterior surface of the pubes by a finger introduced into the vagina—for it is designed for females only.

Harris' instrument seems to be an elaboration of this idea; his tube is a pair of catheters connected by a longitudinal hinge which permits the rotation of each beak, when in the bladder, toward one of the ureters. The partition between the two subdivisions of the bladder is made entirely

<sup>1</sup> *Journal of Cutaneous and Genito-Urinary Diseases*, December, 1898.

<sup>2</sup> *Proceedings of French Urological Assn.*, 1898.

<sup>3</sup> *Ibid.*

<sup>4</sup> *Deutsche med. Wochenschrift*, 1897, No. 43.

<sup>5</sup> *Medicine*, April, 1898.

by elevating the floor of this viscus by means of a lever introduced into the vagina of the female and the rectum of the male.

Neumann's instrument does not seem to have been generally used; Harris' has been extensively tried in this country, and the limitations theoretically evident have been demonstrated in practice. Two serious defects are obvious: each of the catheters drains half the bladder as well as one kidney, and the flow from it must include any pus, blood, bacteria, etc., that may be furnished by the vesical lining, since the bladder mucous membrane is not abolished but merely corrugated when this viscus is empty. Again, the partition wall made by lifting the bladder floor may well be defective through firmness of the trigonum, pockets and diverticula, enlargement of the prostate, etc., and the instrument affords no means for determining whether the partition is water-tight.

These theoretical criticisms have been realized in practice by different observers. At a meeting of the Genito-urinary Section of the New York Academy of Medicine, at which Harris discussed his instrument, Sondern<sup>1</sup> and Ellsberg<sup>2</sup> narrated experiences showing the fallacy of conclusions based on the use of this instrument. In one case of suspected right pyelitis the instrument furnished purulent urine without tubercle bacilli from the right side; clear urine containing such bacilli from the left side. The Kelly catheter gave clear urine without tubercle bacilli from the left side; the cystoscope showed a tuberculous ulcer of the bladder near the left ureter. Used in an elderly woman, the Harris catheter gave fragments of cancerous tissue from one side; the Kelly catheter furnished normal urine from each side; the cystoscope showed epithelioma of the bladder. A third case was a young man whose left kidney had been removed for suppuration about a year before; two months after operation the urine again became cloudy. The Harris instrument, at each of three sittings, furnished nearly equal quantities of urine from the two sides, escaping synchronously and intermittently from both catheters; that from the left (nephrectomized) side contained albumin, pus, urea, and uric acid, though the kidney had been completely removed.

Johnson,<sup>3</sup> using the Harris instrument on a female patient, obtained thick pus from the left side, and from the right "urine very slightly clouded, containing a small amount of albumin and a moderate number of pus and epithelial cells." The left kidney was removed—calculous pyonephrosis; after recovery the urine was normal. Johnson concludes that the urine from the healthy kidney flowing through the Harris instrument was "slightly contaminated from the other side, of the bladder."

<sup>1</sup> Journal of Cutaneous and Genito-Urinary Diseases, May, 1899.

<sup>2</sup> Ibid.

<sup>3</sup> Annals of Surgery, 1899, p. 328.



It would seem, therefore, that the Harris instrument (and Neumann's is probably no more trustworthy) cannot be relied upon, even in females; its findings should be compared with and corrected by those of the cystoscope and ureteral catheter; to these instruments it can be at best a supplement, but it is not a substitute for either. The ease with which it can be used by an inexperienced hand renders its lack of precision the more serious.

## DISEASES OF THE BLADDER.

The extreme value of the cystoscope in the diagnosis of bladder and kidney diseases seems as yet scarcely appreciated by physicians in general, though the detection of ulcers, tumors, concealed calculi, etc., is often impossible in any other way except by cystotomy; and these morbid conditions constitute quite a large percentage of the cases that are blindly treated as "cystitis." This term designates a bacterial affection which is always a secondary, not a primary, disease; a symptom, not an entity. The factor preceding and underlying cystitis, which makes bacterial infection possible, often remains undiscovered until the cystoscope is used.

**Cystitis.** The etiology of bladder infections has been extensively studied by the French school, with results already reviewed (see Pyogenic Infections); and our most efficient agent against them—after the removal of the cause—has come into use under the name urotropin, discussed in the same section.

**TREATMENT.** For irrigations of the chronically inflamed bladder and prostate, clinical evidence seems to favor the following in weak solutions: Potassium permanganate against the colon bacillus; corrosive sublimate against the staphylococcus, streptococcus, typhoid and tubercle bacilli; zinc chloride against the tubercle bacillus; copper sulphate against the gonococcus; silver nitrate against all except the tubercle bacillus (which infection is aggravated by it). The French school favors also 5 per cent. iodoform emulsion in oil of vaseline; they inject two or three ounces of this, leave it in the bladder, and instruct the patient thereafter to watch during urination and stop when the oil begins to appear. Since the oil floats upon the urine in the bladder, the observance of this injunction would keep the bladder more or less continuously bathed in this emulsion—a "permanent iodoform dressing of the bladder," as Bazy calls it. The injection is renewed every few days; the addition of guaiacol, 1 to 3 per cent., is advised by Pousson, especially in tuberculous cystitis.

**DRAINAGE OF THE BLADDER BY THE RETAINED CATHETER** is a most valuable and often neglected means for reducing subacute and

chronic cystitis. The instrument should be a red-rubber catheter, and should be removed at least once, better twice, daily for cleansing; at each removal the urethra should be thoroughly irrigated, as a protection against infection. This measure is especially valuable in the cystitis of prostatic enlargement.

Various writers have called attention to the fact that the cystitis so frequent after pelvic operations and confinement is due not to the use of unclean catheters, but to the injury to blood and nerve-supply of the bladder, whereby resistance to bacterial invasion of the tissues is diminished.

BLEEDING from the bladder, when the cause cannot be removed, is treated by injections of weak solutions of silver nitrate, or of the antipyrin and tannic acid mixture (equal parts) recommended by Park. Gelatin solutions, the subcutaneous injection of which has often coagulated the blood in aneurismal sacs, failed entirely to arrest the bleeding from a bladder tumor in four cases.<sup>1</sup>

**Bladder Tumors.** Some suggestion as to the etiology of connective tissue tumors of the bladder is offered in the observation by Leichtenstein and Posner,<sup>2</sup> that such tumors, resembling sarcoma in gross and microscopical appearances, have been repeatedly observed in workers in aniline factories; the workmen so afflicted have long inhaled the vapors of toluidin, naphthylamin, and nitrobenzol. One such sufferer recovered by abandoning his work; another was operated on by Bardenheuer, who found a great thickening of the connective tissue in the bladder, suggesting sarcoma. The spontaneous recovery in one case and the absence of metastases (upon autopsy) in the operated case indicate a lack of the usual malignancy of clinical sarcomata. Huldshiner<sup>3</sup> reported experimental feeding of rabbits with the aniline derivatives, with the production of similar growths in the bladder; in one animal pronounced oxaluria was observed during the experiment, suggesting the hypothesis that the aniline derivatives administered—known to be deoxidizing agents outside of the body—interfere with normal oxidation processes in the living animal, and thereby cause the production of oxalic instead of carbonic acid in the tissues, and that oxalic acid is the immediate cause of the sarcoma-like hypertrophy.

A curiosity among bladder tumors in temperate climates was met by Curtis<sup>4</sup> in a young man who had suffered for six years from hæmaturia. The cystoscope having revealed tumors, Curtis removed them through a suprapubic incision and found them to enclose eggs of the distoma hæmatobium.

<sup>1</sup> *Annales d. Mal. d. Organe Genito-Urinaire*, August, 1898.

<sup>2</sup> *Berliner klin. Wochenschrift*, 1898, No. 45.

<sup>3</sup> *Ibid.*

<sup>4</sup> *British Medical Journal*, October, 1897.

**Extirpation and Resection of the Bladder.** Since Gluck, in 1881, showed the feasibility of removing the bladder from dogs, various surgeons have performed this operation for malignant and tuberculous disease in the human subject. Wendel<sup>1</sup> collected ten cases, of which six died within a few days; six successful cases have been reported since the publication of his article.

Of 57 resections of the bladder collected by Wendel, 14 died of the operation, 14 of recurrence, while 21 were known to be well for periods ranging from two months to five years. Fuller<sup>2</sup> reports a case of resection of the bladder and removal of the prostate for sarcoma, which is noteworthy because of the recovery of good vesical function; the patient died eleven months later from recurrence.

**Hernia of the Bladder** occurring in all directions is described in the 180 cases collected by Brunner.<sup>3</sup> It is found three times oftener in men than in women, usually in middle or advanced life; it is most frequently inguinal in men and crural in women; there is naturally a proneness to calculus formation in the extruded portion of the bladder. Of 81 such cases in which the bladder was injured during operations for intestinal hernia, etc., 21 died, at least 12 of them in consequence of the bladder injury.

**Vesico-intestinal Fistulæ** are discussed by Chavannez,<sup>4</sup> who collects 95 cases from the literature. In 18 of these operative attempts to close the fistula were made; those by laparotomy failed; of 11 cases operated on by colotomy 9 died; 1 case of suture from the bladder was partly successful, while three sutures from the rectum were entirely successful.

**Exstrophy of the Bladder** has been the object of recent tentative operations, of which Maydl's has gained the most favor, having been successfully performed in twenty cases. The essential feature of this method is the transplantation of the trigonum, carrying the ureteral orifices into the colon, the rest of the exstrophied bladder being excised and the abdominal and pelvic hiatus closed. Rutkowski<sup>5</sup> has successfully operated on one case, a twelve-year-old boy, by a new method; he used a piece of the intestinal wall as a substitute for the missing anterior segment of the bladder, and closed the abdominal wall over the completed bladder. The lack of a vesical sphincter compelled the use of a pressure pad, which enabled the boy, eight weeks after the operation, to retain nearly an ounce of urine.

<sup>1</sup> Beiträge z. klin. Chirurgie, Band xxii.

<sup>2</sup> Journal of Cutaneous and Genito-Urinary Diseases, 1898, p. 581.

<sup>3</sup> Deutsche Zeitschr. f. Chirurgie, Band xlvii., Heft 2 and 3.

<sup>4</sup> Annales d. Mal. d. Organe Genito-Urinaire, November, 1897, to February, 1898.

<sup>5</sup> Centralbl. f. Chirurgie, 1899, No. 16.

Walsham<sup>1</sup> critically examines the entire subject of bladder exstrophy in connection with the report of a successful case.

The proper *disposition of the ureters* is a serious problem in cases of bladder exstrophy, bladder extirpation, and ureteral fistula following hysterectomy, etc. The difficulties to be avoided are stricture of the new ureteral orifices and ascending septic infection. Vassilieff's method after extirpation—sewing the ureteral ends into the skin—fairly prevents these dangers, but submits the patient to obvious miseries. Transplantation of the ureters into the rectum is suggested as the least unnatural disposition of them, both by the natural structure of birds and by this congenital malformation in Richardson's case, a seventeen-year-old youth, who had perfect urinary functions. Moreover, since the rectum is usually empty, it may, and in several cases has, acted as well as a bladder, the urine being independently voided several times daily, while the feces, collecting in the sigmoid flexure, have been expelled at the usual intervals. Yet various considerations, largely anatomical, have induced surgeons to prefer transplantation into the sigmoid or descending colon; the preservation of the entire trigonum, when this is available, has the great advantage of maintaining the natural ureteral orifices—the best possible protection against both stricture and infection. In cases where a functioning bladder exists, as in ureteral fistulæ following laparotomy or hysterectomy, Witzel's<sup>2</sup> plan of introducing the upper segment through the bladder wall remains the best procedure.

**Rupture of the Bladder.** Mitchell<sup>3</sup> reports a case of extraperitoneal rupture with fracture of the pelvis; after suture of the bladder the woman was placed in a warm bath (100° F.) almost continuously for forty days, with excellent recovery. He collects 90 cases of rupture of the bladder complicated with fracture of the pelvis.

**Calculi.** The exact field of litholapaxy is still the subject of discussion, the prolonged anæsthesia and tendency to recurrence constituting the essential arguments against it. The friends of the operation deny that especial tendency to recurrence pertains to the operation itself, ascribing it in practice to lack of experience and skill of the operator. This criticism can hardly apply to such surgeons as Guyon and R. Harrison, however; yet the latter<sup>4</sup> reports 101 litholapaxies, with 6 deaths and 23 recurrences (24 per cent.). He advises that the bladder be washed frequently for weeks after the operation, for the removal of particles that may originally have escaped the evacuator. Albarran admits that the operator can never be sure of complete evacuation unless the bladder be inspected for fragments through the cystoscope. He, too, advises repeated washings of the bladder subsequent to operation.

<sup>1</sup> Practitioner, 1899, p. 151.

<sup>2</sup> Annals of Surgery, 1898, p. 151.

<sup>3</sup> Centralbl. f. Gynäkologie, 1896, No. 11.

<sup>4</sup> Lancet, November 12, 1898.

Guyon's teaching is undoubtedly correct, that recurrence is independent of the operator when chronic inflammation or imperfect evacuation of the bladder persists. In such cases, including many prostatics, repeated evacuations with the aspirator at short intervals should be practised. Guiard mentions such a case in which litholapaxy was made five times in eighteen months by Guyon; afterward Guiard aspirated every five or six weeks for eight or nine years, usually extracting minute phosphatic concretions.

Chismore,<sup>1</sup> whose evacuating lithotrite is favorably known, describes an attachment which greatly increases the crushing power of the lithotrite, and relates that with this he easily broke a large stone which Harrison had been compelled to remove by incision because unable to crush it with the usual instruments.

CYSTOTOMY. Dandridge,<sup>2</sup> in an able article, discusses the relative merits and disadvantages of suprapubic and perineal incisions for all purposes. Clarke<sup>3</sup> recalls attention to the frequency of encysted vesical calculi, having found twenty-one in his own practice. The one constant symptom is cystitis; this is sometimes so improved by treatment that the stone remains unsuspected. His routine practice is to make a digital exploration of the bladder when medical treatment fails.

For the suprapubic operation the dangerous rectal bag of Petersen has been generally supplanted by the Trendelenburg position. Distention of the bladder with air, instead of water, has obvious advantages that will doubtless lead to its general adoption. The alleged danger of forcing air into the ureters, renal pelves, and veins, with consequent air embolism, asserted by Lewin and Goldschmidt,<sup>4</sup> has been abundantly dispelled by clinical as well as by experimental evidence. Lewis<sup>5</sup> distended the bladder of a dog with air, and then compressed it manually until it burst, without forcing air into the ureters; then introducing a canula into a ureter, he distended the renal pelvis to the utmost without observing the entrance of air into the veins or otherwise disturbing the dog's circulation. He recalls the negative results of Hare's<sup>6</sup> efforts to induce fatal embolism by injecting 20 c.c. of air directly into the left jugular vein of a dog, and finally produces the clinical testimony of several experienced surgeons to the harmlessness of air-distention of the bladder. Lewis' article should effectually dispel the ill-grounded belief in the danger of this valuable method.

<sup>1</sup> *Journal of Cutaneous and Genito-Urinary Diseases*, October, 1898.

<sup>2</sup> *Annals of Surgery*, July, 1899.

<sup>3</sup> *Loc. cit.*

<sup>4</sup> *Deutsche med. Wochenschrift*, 1897, No. 38.

<sup>5</sup> *New York Medical Record*, March 25, 1899.

<sup>6</sup> *Therapeutic Gazette*, September 16, 1889.

**Sterilization of Catheters.** Many agents and methods have been recommended on rather insufficient grounds for this purpose—3 per cent. formalin in glycerin, 1 per cent. sublimate in equal parts of glycerin and water, etc. While no difficulty is experienced with metal and rubber catheters, which can be heated and boiled, the sterilization of the semi-rigid gum catheters is still an unsolved problem. Nicoll,<sup>1</sup> as the result of an elaborate bacteriological study of this subject, offers the following excellent rules for practice:

Use red-rubber catheters by preference; these can be sterilized like metallic instruments, by boiling or by chemical antiseptics.

When stiff gum or varnished catheters must be used, destroy them if the urine be very septic; otherwise wash carefully with soap and water and with an antiseptic solution, and then steam them; those which survive this treatment—and they are few—may be retained. It is practically impossible to sterilize gum and varnished catheters without destroying the coating or the material.

### **URETHRAL STRICTURE.**

Resection of the urethra for extensive cicatricial stricture has been attended with gratifying success. Tuttle,<sup>2</sup> in connection with the report of a case in which he had successfully resected the perineal urethra for complete closure, refers to eighteen cases in the literature in which the excised portions have measured 3.5 to 4.5 cm. in length. Wagner<sup>3</sup> relates that Mikulicz has during the past ten years repeatedly excised portions of the urethra 2 to 4 cm. long.

Nogues<sup>4</sup> reports the following case: The patient when seven years old sustained a rupture of the urethra, with subsequent perineal stricture; between 1888 and 1891 he submitted to internal urethrotomy three times and to external urethrotomy once, recontraction promptly following each operation. In 1891, Guyon resected the floor of the urethra (the upper wall being intact) and sutured without drainage, securing primary union. The canal was kept open to 44 beniqué till 1897, when the patient disappeared; fourteen months later he returned with the urethra contracted to 14 beniqué, but it was easily dilated.

Tilden Brown<sup>5</sup> reports a case in which the patient had been compelled to wear a silver catheter continuously for twenty-four years to prevent the contraction of a dense stricture. Brown made a plastic resection of the urethra, restoring the full calibre, which was maintained without the use of instruments at the time of the report, ten months later.

<sup>1</sup> *Annals of Surgery*, June, 1899.

<sup>2</sup> *Journal of Cutaneous and Genito-Urinary Diseases*, June, 1899.

<sup>3</sup> *Centralbl. f. Chirurgie*, 1898, No. 30.

<sup>4</sup> *Annales d. Mal. d. Organe Genito-Urinaire*, 1899, p. 166.

<sup>5</sup> *Journal of Cutaneous and Genito-Urinary Diseases*, April, 1899.

**DISEASES OF THE PROSTATE.**

**Treatment.** Two therapeutic innovations have materially advanced the medical treatment of chronic prostatitis and prostatic enlargement: urotropin and massage of the prostate.

UROTROPIN is directly valuable merely in arresting the growth of bacteria in the prostatic follicles and the bladder; but by so doing it indirectly arrests also the reactive inflammation, reduces œdema, and to that extent restores the dilatability of the vesical sphincter. Certain of these cases are greatly improved by it; the cystitis subsides, difficulty in urination is lessened, residual urine decreased, and a decided reduction in the size of the prostate, due to subsidence of the inflammatory swelling, is noted. The effects of this drug are in such cases more prompt, pronounced, and lasting than have been obtained, in my observation, by any other medicinal measures, local or internal.

MASSAGE OR MILKING OF THE PROSTATE is another measure of great value in chronic prostatitis and in the early stage of prostatic enlargement, for it empties the distended follicles and utricle of their purulent contents, and thus diminishes the vesical irritation and the inflammatory swelling of the prostate. It is of little or no value in the sclerotic stage of connective tissue excess.

OPERATIVE TREATMENT. The last five years have been prolific of operative attempts to relieve the sufferings secondary to prostatic enlargement. The standard operations of the previous decade, bladder drainage and prostatectomy, having left much to be desired, new operations have been cordially welcomed and promptly tried. The chief of these have been double castration, double vasectomy, and Freudenberg's modification of Bottini's operation.

Since 1893, when Ramm in two cases executed, and White independently suggested, double castration as a means for securing atrophy of the enlarged prostate, this operation has been extensively practised. Though, as was to be expected, the simple technique favored promiscuous and ill-advised operating, and though castration was performed for bladder disease subsequently found to result from vesical calculus, etc., yet general experience has now established the anatomical effects and clinical value of the operation; it produces an atrophy of the glandular tissue and decrease of blood-supply in the prostate. In certain cases a symptomatic cure with decided decrease in the size of the prostate has resulted; in others improvement in symptoms without decided effect upon the volume of the prostate; while in still others no appreciable permanent effect upon either has followed. The natural aversion to loss of the testicles, even when merely "anatomical ornaments," led to the

substitution by Harrison of the excision of a portion of each vas deferens—an operation practically free from all the objections to double castration, including the mortality and need for general anæsthesia.

The failure of both these operations on the sexual organs to relieve many patients stimulated the revival of a procedure for which Bottini claimed good results twenty-five years ago, but which had never been generally adopted. The charms of this operation to the average patient—freedom from cutting and from general anæsthesia—favored the rapid accumulation of experience with this method also.

The history of the average sufferer from prostatic enlargement presents great extremes in the severity of the bladder symptoms, extremes which are apt to succeed one another in the course of consecutive weeks. A prostatic who has had no symptom beyond slightly increased frequency of urination may suddenly, after hearty eating or drinking, chilling, etc., experience complete retention; and if the catheter be used intelligently, he may in a few days regain his former state and enjoy it for many months without further assistance. Cases of this kind, known to every surgeon of experience, are recalled by Héresco<sup>1</sup> in relating the history of a patient recently admitted to the Necker Hospital. Ten years before, when sixty-four years old, this man had suffered an acute complete retention of urine; after ten days' treatment with the catheter his vesical function was practically restored, no catheter or nocturnal urination being required. Ten years later (at seventy-four years) complete retention again occurred, at which time he came under Héresco's care; after eight days' treatment with a catheter he regained the power of urination, and his urine remained clear. The records of the Necker Hospital contain the history of seven similar cases, in which the intervals between such attacks ranged from four to eleven years. Such cases would have been, as Héresco aptly remarks, brilliant cures for any operative method that might have been employed on them; yet the records of double castration, vasectomy, and the Bottini operation include cases plainly belonging in this category—submitted to operation by enthusiasm unmixed with experience.

There is another large class of prostatitis who suffer at intervals from cystitis and who secure relief for long periods through the internal use of urotropin, or the irrigation of the bladder neck with weak solutions of silver nitrate, or by drainage through the retained catheter. During the attacks the symptoms may be quite severe, yet in a few days they entirely disappear. Grenouille presented to the last meeting of the French Urological Association eighteen temperature charts from Guyon's service, showing the curative effects of the retained catheter in acute

<sup>1</sup> *Annales d. Mal. d. Organe Genito-Urinaire*, 1899, p. 154.



infections of this kind. Yet many such cases also figure among the triumphant cures of the three methods under discussion.

The primary lesion in cases of enlarged prostate is obstruction to urination either by tumor formation, elevation of the vesical outlet, or fibroid degeneration of the vesical sphincter, or by a combination of these. The secondary factor which causes the acute symptoms is bacterial infection of the prostatic glands, with the reactive inflammation; from this latter results an œdematous swelling of the entire prostate, including the vesical sphincter, with consequent impairment of the dilatibility of the vesical outlet. Naturally, any agent which will arrest the bacterial infection and consequent œdema—whether urotropin, lavage, retained catheter, cautery of the prostatic follicles or other operation—will relieve the acute symptoms, reduce the apparent size of the prostate, and diminish the urinary impediment without removing the underlying cause, the persistence of which must render subsequent infections probable, and the label “cured” absurd. Such a patient can be called cured only when, in addition to the abolition of infection, there is complete evacuation of the bladder, shown by the entire absence of residual urine; and unless the sclerosis of the prostate is permanently arrested, the cure is even then to be considered merely tentative.

These considerations exclude from discussion many of the cases reported, and hence invalidate the deductions that might be drawn from these reports as to the value of these operations; for many evidently needed no operation, in many others the residual urine is not mentioned, and others still are reported a few weeks after operation.

The available material seems to me to justify the following conclusions:

1. *Castration* regularly causes, primarily, oligæmia of the prostate and atrophy of the glandular elements; the effect on the muscular portion is variable, while the connective tissue seems to be generally uninfluenced. The secondary effects are abolition of existing bacterial infections (which is doubtless permanent, because the glands are destroyed) and such decrease in the size of the organ as must follow the reduced blood-supply, arrest of inflammation, and atrophy of epithelium.

The clinical results vary according to the degree of restoration of complete vesical evacuation; and this naturally depends upon (a) the removal of impediments to the exit of urine and (b) the integrity of the vesical musculature. If there be an excess of connective tissue in the prostate and consequent persistence of the urinary impediments, or if, though these be removed, the bladder muscles are so impaired that complete evacuation is impossible—in either case bacterial infection of the bladder and symptoms of cystitis persist. Residual urine always threatens cystitis in spite of prostatic atrophy.

In another class of cases the prostatic hypertrophy consists largely of

connective tissue which has invaded the vesical sphincter ; hence the prostate is not materially reduced nor the power of urination restored by castration ; residual urine and bacterial infection may persist undiminished. The case of Freudenberg, which did much to resurrect the Bottini operation, seems to have been one of this class ; for castration performed three years before had not restored the patient's ability to urinate without the use of the catheter, while after the Bottini operation (which doubtless ploughed a furrow through the fibroid sphincter) he dispensed with the catheter. This fibroid condition of the vesical sphincter is an important factor in many cases of prostatic enlargement ; that it may exist and provoke cystitis without any enlargement of the prostate is shown by the observations of Post and myself,<sup>1</sup> and the more recent case of Fuller.<sup>2</sup>

2. *Double vasectomy*, which has no apparent relation to the prostate, has produced most diverse effects upon that organ, varying from complete atrophy to complete absence of anatomical change. The explanation of this diversity of results seems to be furnished by the work of Albarran and Motz,<sup>3</sup> who found that in animals gradual atrophy of the testicles as well as of the prostate follows resection of the other elements of the spermatic cord, excluding the vas deferens, artery, and two or three veins. This procedure, which they call angioneurectomy, they have practised upon six human subjects of prostatic hypertrophy, who exhibited subsequent atrophy of the prostate and testicles. Their work suggests the possibility that the effect upon the prostate attributed to vasectomy is really due to the resection of elements of the cord other than the vas, and that the diversity of clinical results following vasectomy is to be explained by the variations in the anatomical elements injured during the operation. Indeed, Przemalski<sup>4</sup> decided by experiment on animals that atrophy of the prostate is induced by resection of Cooper's nerves (*nervi spermatici interni*), which accompany the artery of the cord.

The clinical results of vasectomy have varied as widely as have its effects on the prostate. It is, however, the general experience of surgeons that while the results of castration are permanent, the favorable effects of vasectomy (when these are observed) are often transient, and are apparently due merely to a relief of prostatic congestion ; the patient's improvement, which may be decided for a few weeks or months, may entirely disappear within a year after operation. On the other hand, the six cases of Albarran's angioneurectomy experienced a relief that had lasted a year at the time of report.

<sup>1</sup> *Morrow's System of Genito-Urinary Diseases*, 1893, p. 357.

<sup>2</sup> *American Journal of the Medical Sciences*, October, 1897.

<sup>3</sup> *Annales d. Mal. d. Organe Genito-Urinaire*, March, 1898.

<sup>4</sup> *Méd. Moderne*, 1897, No. 73.

The records of published cases of operation on the sexual organs for the relief of enlarged prostate are in part as follows: Köhler collects 167 vasectomies, resulting in 36 cures, 15 improvements, 3 deaths, while 113 remained unimproved. Mikulicz made 44 vasectomies; in 10 there was a decrease in the size of the prostate; in these and in 17 others decided improvement in symptoms; in 7 no improvement, and 10 died; the improvement was, however, generally transient. The same surgeon made 50 double castrations, of which 9 died, 1 became insane, and 29 were improved, with a decrease in size of the prostate; 3 cases in which vasectomy had failed were submitted to castration, which were also unsuccessful. Englisch<sup>1</sup> collected 270 cases of operation on the sexual organs: 154 double castrations, of which 42 were cured, 73 improved, 14 useless, and 25 died. Of 116 double vasectomies, 25 were cured, 62 improved, 22 useless, and 7 died. To the French Association, Lombeau, in 1898, reported 21 cases in which double vasectomy had produced no appreciable effect whatever, though the patients were observed for periods of three to seventeen months thereafter. Nicolich<sup>2</sup> reported 27 double vasectomies, with 8 cures—*i. e.*, emptying the bladder completely—14 improvements, and 5 failures. Desnos<sup>3</sup> observed poor results after vasectomy; in one case it had been followed by complete retention and permanent dependence upon the catheter. Steiner<sup>4</sup> made seven double castrations and one double vasectomy, all useless except one; this man, seventy-one years old, had had urinary difficulties for seven years; he also exhibited atrophy of the testicles, complete in one and almost complete in the other, both following double epididymitis when he was twelve years old. In this case double castration caused distinct decrease of cystitis and improvement in urinary ability.

These specimen reports from the literature fairly indicate the frequent failure of castration, and prove it in any given case a purely tentative procedure, made at the sacrifice of the testicles and at a not inconsiderable risk to life itself. The results of double vasectomy are decidedly less successful, though this operation is practically free from danger and is easily made without general anæsthesia. Albarran's angioneurectomy seems to combine the success of castration with the safety of vasectomy; his cases, though few in number, are convincing, because they had all received intelligent treatment with the catheter before the operation was performed.

3. *Bottini's Operation.* One of the earliest attempts to secure relief in cases of enlarged prostate was Mercier's operation, devised and practised over forty years ago, and soon after abandoned. It assumed that the

<sup>1</sup> Wiener medicinische Wochenschrift, 1897.

<sup>2</sup> Ibid.

<sup>3</sup> Ibid.

<sup>4</sup> Centralbl. f. Krankheiten d. Harn. u. Sexuale Organ, 1898, p. 462.

cause of the patient's trouble was a "bar at the neck of the bladder," the division of which should remove the obstruction to the exit of urine. To effect the division of this bar Mercier used an instrument similar in general plan to the modern lithotrite, except that the male blade was armed with a cutting edge instead of a crushing surface. Twenty years later Bottini modified Mercier's instrument by substituting a cauterizing for a cutting edge, thereby reducing the danger of hemorrhage and sepsis. Though Bottini exploited this modified Mercier operation twenty-five years ago, it secured no general recognition. Some three years ago it was resurrected by Freudenberg, in Berlin, who modified and improved the Bottini instrument and reported favorable results. A fair statement of the results claimed by various operators is furnished in the 127 cases collected by Frisch;<sup>1</sup> of these 62 (49 per cent.) were reported cured, 34 improved, 22 unimproved, and 9 (7 per cent.) died. Stockmann<sup>2</sup> reviews 229 cases, of which 51.5 per cent. were reported cured, 26.2 per cent. improved, 13.9 per cent. unimproved, and 8.2 per cent. died.

No surgeon who is familiar with the varied morbid conditions discovered upon digital examination of the prostate can expect an instrument introduced through the urethra, without digital or visual control, accurately to detect and remove these obstacles of such diverse nature, form, and locality. The Bottini operation can evidently make no pretence to curing—*i. e.*, removing—enlargement of the prostate, as this has often been cured by castration and by prostatectomy.

In practice, however, the patient may reasonably be considered cured who completely empties the bladder at each urination, even though the bulk of the enlarged prostate remains undiminished. A permanent low-level channel from the vesical cavity to the membranous urethra—even though it be but a canyon bordered by towering masses of prostatic tissue—may afford as complete a cure of vesical disease as the removal of these masses by prostatectomy or castration could secure. That the Bottini operation effects such a cure is the claim made by its advocates.

A critical review of the cases reported shows that many belong in the categories to which I have already called attention—those that recover spontaneously or under simple treatment, including the intelligent use of the catheter—cases which are brilliant successes for any operation. Many of them, however, are entitled to recognition—cases in which the patient has had, in spite of judicious treatment, chronic retention and cystitis before operation, and complete unaided evacuation of the bladder thereafter. In these cases the operator has succeeded in cauterizing a channel through the obstruction to the exit of urine. Whether or not this channel will be permanent; whether the further progress of the hyper-

<sup>1</sup> Wiener klin. Wochenschrift, 1898, No. 48.

<sup>2</sup> Deutsche med. Wochenschrift, 1899, Nos. 1 and 2.

trophy may not diminish or even obliterate it, is a question which cannot yet be answered, since few of these cases are over two years old.

The accompanying cut (Fig. 9), reproduced from the *American Journal of Surgery and Gynecology*, through the courtesy of the operator, Dr. Bransford Lewis, pictures a bladder and prostate removed sixty days after the Bottini operation had been performed (the patient dying of sepsis after a subsequent operation for hernia). Because of the patient's

FIG. 9.



A, interureteric fold ; B, middle lobe ; C, groove made by electro-incisor.

feeble condition only one incision had been made in the prostate instead of three, as is recommended. This man had had no treatment prior to operation ; the residual urine (twenty-eight ounces on admission to the hospital) was reduced to two or three ounces a month after the operation, but was not entirely clear ; and the frequency of urination was correspondingly reduced from thirty-five to seven or eight times in each twenty-four hours. This case shows that the Bottini operation may achieve marked success even under unfavorable conditions ; yet equally

successful results have often followed non-operative treatment; it is, moreover, evident that this case cannot be ranked among the cures, the residual urine being a constant menace of further trouble. One wonders how long the slight channel made by the incisor (described at the autopsy as large enough to admit a lead pencil) would have preserved its lumen against the encroachment of the growing prostatic tissue; and it is evident that the incisor, had it been guided by a finger in the bladder, must have made a more satisfactory channel.

*Relative Values of Castration, Vasectomy, and Bottini's Operation.* These three are purely tentative measures; in none of them does the surgeon know the contour or composition of the impediment to urination; in none can he predict, even at its close, the effect of his operation on this impediment; in none can he assert the absence of encysted calculi. The objections to castration are the loss of the testicles, general anæsthesia, and the mortality (8 or 10 per cent.); to vasectomy, the uncertain and transient nature of its effects; to Bottini's operation, the mortality (7 to 9 per cent.) and the danger of acute sepsis of the urinary tract, and of hemorrhage.

The clinical successes seem to be most numerous for castration and fewest for vasectomy, with the Bottini operation occupying a middle position; though Wossidlo,<sup>1</sup> reviewing 472 cases of all three operations collected from the literature, considers the results of the Bottini operation better than those of castration, and Stockmann<sup>2</sup> considers the successes of the three methods about parallel. Their simplicity recommends them to physicians; the slight cutting in vasectomy, and the absence of the knife in the Bottini method, and especially the avoidance of general anæsthesia in both, recommend the two latter to patients.

Evidently none of these operations is the desired solution of the prostatic problem, nor do the results of any equal those furnished by the prostatectomy of later years, such as Nicoll's, Alexander's, and Fuller's operations. Yet these are serious operations which all wish to avoid, and which some are unable to endure. My own experience began with the following case,<sup>3</sup> operated on in 1885, and reported the following year:

In a patient fifty-nine years old, who had been the subject of chronic cystitis for years, and entirely dependent upon the catheter for two years, I cauterized, from a perineal incision, a channel through the obstructing prostate large enough to admit the forefinger. Thereafter he emptied the bladder almost completely without the aid of a catheter. Death from acute uræmia occurred nine months later, the autopsy showing cirrhotic kidneys and a capacious, low-level channel from bladder to urethra.

<sup>1</sup> Deutsche Praxis, 1898, Nos. 14 and 15.

<sup>2</sup> Loc. cit.

<sup>3</sup> Journal of American Medical Association, 1886, p. 244.

Fourteen years' experience with various operations have led me to the following conclusions and practice :

1. The introduction of a finger into the bladder, preferably through a suprapubic incision, is essential to an intelligent operation ; all measures which ignore this feature are blind experiments.

2. A cauterizing instrument (Bottini's or other) introduced through the urethra and guided by the finger in the bladder can be made not only to plough a large furrow through obstructions to urinary exit, but also to destroy protruding masses of prostatic tissue.

3. Complete evacuation of the bladder must be proven before even a symptomatic "cure" can be claimed.

4. In certain cases the permanent impairment (atony) of the vesical musculature renders such a cure impossible, even though all obstacles to urinary exit be removed.

5. The suprapubic incision needed for the guiding finger can be made under local anæsthesia by cocaine or nirvanin when necessary.

The patient's dread of the knife and general anæsthesia create a field for simple, safe, and uncertain vasectomy, and for the simple, unsafe, and uncertain Bottini procedure, each of which must be considered a sacrifice of accuracy to the fears of either patient or operator. Vasectomy may be justified as an experiment which may do some good without doing any harm; but the mortality of the Bottini operation (7 to 9 per cent.) almost equals that of recent prostatectomy.





# FRACTURES, DISLOCATIONS, AMPUTATIONS, SURGERY OF THE EXTREMITIES, AND ORTHOPEDICS.

By JOSEPH C. BLOODGOOD, M.D.

## SURGICAL SHOCK.

POST-OPERATIVE surgical shock is seldom observed when the surgeon exercises the most minute care to check even the smallest bleeding-point. In non-traumatic surgery it is loss of blood that contributes chiefly to shock. This loss of blood can and should always be conscientiously prevented. In long operations the slightest oozing should be checked. *Eternal vigilance* against hemorrhage should be the watchword of every operator.

The shock observed now and then in critically ill patients during and after operations, if not associated with loss of blood, is never to be feared so much as that associated with hemorrhage. We have never lost a patient from loss of blood or from shock after a complete Halsted operation for carcinoma of the breast. The operation is always a long one—from two to three hours, and often four hours—and many patients are feeble women of advanced years.

The recognition and treatment of shock after recent injuries is a most important one, and military and civil surgeons all agree that hemorrhage and exposure to cold are the most dangerous factors. Shock, from the nature and extent of the injury, not associated with loss of blood or injury to the brain or spinal cord, if not followed at once by death, never produces the same mortality as when the same condition is associated with hemorrhage.

Surgeon-Colonel Stevenson<sup>1</sup> says, on page 89 of his excellent *War Surgery*, that 85 per cent. is an underestimate of the proportion of deaths on the field from primary hemorrhage. On the battle-field the immediate checking of hemorrhage is one of the most important procedures; in civil practice the surgeon seldom sees the injured patient in time to check the fatal loss of blood. It is, no doubt, a very important question as to how many lives would be saved by properly educating the

<sup>1</sup> Wounds in War. Longmans, Green & Co., London, 1897.

police force and even the general public in the proper (and usually very simple) method of immediately checking hemorrhage after injuries.

George W. Crile<sup>1</sup> has published an important essay on "Surgical Shock," to which was awarded the Cartwright prize for 1897. The study is one entirely in experimental physiology, and although, as Crile himself says, not conclusive, yet the essay is well worth reading, and from it every surgeon will derive practical benefit. I sincerely trust someone will be stimulated to continue the investigation in this most important subject.

This history of the theories concerning shock and the cases attended by shock given by Crile we are all familiar with. Crile gives in careful detail his method of investigation and the protocols of 138 operative experiments on animals. The protocols of the experiments Nos. 138 to 148 are not given. They were devoted to observations on the effect upon the intracranial pressure produced by introducing salt solution into the lateral ventricle through a small pipette. Crile's results in the latter cases agree with those published by Horsley and Spencer. A complete discussion is given of the effect produced by cutting, tearing, or otherwise injuring the various tissues, organs, and regions of the body, and from this Crile deduces the factors causing shock :

1. THE DURATION OF THE OPERATION was found to be an important factor. Continuous ether anæsthesia, carefully given, killed dogs in about ten hours ; so that if death took place from shock in two hours the pure anæsthetic elements were calculated at 20 per cent. Crile says this applies to ether only, and that there is strong evidence that chloroform is a more potent factor. The observations on dogs by Crile correspond to those made by others, and the same seems true, clinically, with human beings, that chloroform is a more dangerous anæsthetic, especially in long operations. The much disputed question of anæsthesia is, however, by no means settled.

H. C. Wood and Carter<sup>2</sup> come to the following conclusions after their work on this subject :

1. Lowered arterial pressure has a comparatively feeble effect upon the respiration, but when the pressure falls sufficiently respiratory depression does occur.

2. Even excessive lowering of blood-pressure primarily stimulates the vasomotor centre, the sensibility of the centre being evidently necessary to the automatic regulation of the circulation.

3. The circulation recovers itself more slowly after profound etherization than after a like chloroform narcosis.

<sup>1</sup> An Experimental Study into Surgical Shock. J. B. Lippincott Co., Philadelphia, 1898.

<sup>2</sup> Journal of Experimental Medicine, 1897, vol. ii. p. 150.

4. It is possible for ether as well as chloroform to produce death some hours after the cessation of its administration, at a time when the cerebrum has long freed itself from distinct evidences of the narcotic, so that consciousness and intellectual action have been restored.

In applying these conclusions to the subject of practical anæsthesia, it is evident that the depression of the circulation produced by chloroform has an effect upon the respiratory centres only when the pressure has fallen very low, and, while it may be a factor in the production of respiratory failure during chloroformization, the failure must be chiefly due to the direct influence produced by the drug upon the respiratory centres.

Clinical experience shows that nausea and general depression are more pronounced after the use of ether than after the use of chloroform—a difference which is strongly insisted upon by the advocates of chloroform as an important agent in favor of that anæsthetic. Our research confirms clinical observation, and experimentally shows that the depression of the circulation produced by ether is more permanent than that caused by chloroform, the reason probably being the large amount of ether which is necessary to produce profound narcosis, with lowering of the arterial pressure, an amount so large that it can neither be burned up in the system nor yet eliminated in the time which would be necessary for the much smaller amount of chloroform to be gotten rid of after chloroformization.

In regard to anæsthesia outside of the elements of time, Crile calls attention to the following: Chloroform required much more care than ether. Ether in no instance caused sudden cardiac arrest; chloroform did so three times. The respiratory indication was usually in advance of any other symptom. [Clinically, this is a very important factor: the anæsthetizer should pay as much, and perhaps more, attention to respiration as to the pulse.] Allowing the animal to come out of the anæsthetic and then to narcotize again increased the danger. Repeated narcosis increases its depressant action.

The experiments of Crile, Wood and Carter still leave us somewhat in doubt as to the safer anæsthetic. Practically, the great majority of surgeons whose experience is large prefer ether, especially in long operations.

2. THE ELEMENT OF TIME IN RELATION TO THE EXPOSED FIELD. Crile states as follows: "Contact with air is a very great irritant to local tissues, owing to the lowering of local temperature and to the drying. The effect of exposure is strikingly observed in case of the peritoneum, pleura, and brain. Exposure affects particularly the vasomotor mechanism. If a bloodless field of operation, the thigh for example, be exposed it soon becomes suffused with blood, all the vessels become dilated, the translucency of the tissue is lost, and further dissection then becomes

bloody. The brain, when exposed, soon becomes abnormally irritable, and in faradizing the cortex over a given motor area—say the foreleg—there will likely be an overaction. Many adjacent centres may become excited, and not infrequently a general convulsion is produced. However, after a long time the hyperexcitability is followed by non-excitability. In the fresh state, or when the brain is kept covered with normal salt solution, within certain limits of time the motor discharges correspond with the area of cortical stimulation. The same may be said of nerve-tissues generally, and the importance of preventing exposure of the vagi, the splanchnic, and other special nerve-tissues must ever be in mind. Exposure of the thoracic cavity causes great disturbance of respiration, and the time of exposure should be as short as possible. Exposure of the capacious splanchnic area is attended by a rapid dilatation of the splanchnic vessels, leading to intense congestion, thereby detracting a dangerous amount of blood from the somatic circulation and inducing a rapidly declining blood-pressure. Even the apparently bloodless spaces in the omentum become red on exposure. Not only does exposure of the peritoneum cause splanchnic vascular dilatation, but the respirations are unfavorably affected as well. *The element of time in abdominal operations in every experiment was unmistakable.* In animals subjected to extensive removal of integument shock was induced with a rapidity proportional to the area of exposure, and its depth corresponded with the duration of the exposure. The exposure of the tissue, as a factor in the production of shock, was believed to bear a direct ratio to the area and the duration of the exposure."

Clinically, operators appreciate and try to avoid unnecessary extensive and long exposure of the brain, the thoracic and peritoneal cavities, and during the operation they prevent drying by salt solution. In extensive operations on other parts of the body one seldom observes shock from exposure. In one instance I attributed a profound condition of shock to the removal of very extensive skin-grafts; there had been no loss of blood.

3. THE EFFECT OF HEAT AND COLD. Cold air or fluid applied to the exposed area, especially the brain, nerves, and peritoneum, directly increased the shock, while the effect of moderate heat was in striking contrast. No experiments were tried with great heat.

The severe shock associated with extensive burns is well recognized, and during operations we should be just as careful to avoid very hot as very cold solutions.

Bardeen<sup>1</sup> has contributed an excellent piece of work explaining the constitutional symptoms following extensive burns upon a physiological

<sup>1</sup> Journal of Experimental Medicine, 1897, vol. ii. p. 501.

and anatomical basis. His conclusions are based on the histological study of the organs of five children, aged from sixteen months to eight years, who died from four to nine and a half hours after extensive burns. The lesions were essentially like those produced experimentally in animals by the injection of the diphtheria toxin (Welch and Flexner). Death is due chiefly to the toxic substances in the blood-plasma. The rapidity with which the lymphatic lesions developed in Bardeen's cases was one of the most striking features. Nothing has been added to the treatment, and the fatality of extensive burns remains the same. The cause of death has been attributed to shock. Bardeen explains this shock as due to a definite toxæmia, and characteristic pathological lesions, chiefly in the lymphatic glands, are always to be demonstrated. When recovery is possible from the toxæmia modern aseptic and antiseptic methods have greatly reduced the older high mortality from infection.

4. HEMORRHAGE (Crile). "Loss of blood always predisposes to shock, and when considerable, even if it caused but little depression in the blood-pressure, the animal did not withstand so severe or so protracted an operation. Hemorrhage from venous trunks caused the most profound impression."

The effect of shock and loss of blood is felt chiefly by the vasomotor centres and the respiration, and least by the heart. In 103 experiments of Crile, in which the exact number of deaths was recorded, respiration failed first ninety times, the heart in only four, both together nine times.

In shock and loss of blood one should use remedies to stimulate the vasomotor and respiratory centres and fluid to supply the loss of blood.

**Prevention of Shock.** Crile calls attention to the following factors that are clinically well known: (1) The prevention of even the slightest hemorrhage; (2) most careful anæsthesia, the very least amount possible; (3) to maintain the normal warmth of the body; (4) the tilting of the body head down, especially in condition of shock; (5) manipulation of tissues with great care and gentleness, especially the nerve-trunks, the brain, and the peritoneum; (6) hypodermatic injection of atropine acted as a protection against shock. Cocaine guards the heart against cardiac inhibition almost as effectively as atropine. Cocaine applied to nerve-trunks after thirty seconds blocks afferent impulses and prevents the shock due to the section of the nerves. Experiments with morphine and alcohol were negative.

Clinically, we seldom observe sufficient depression after the division of large nerve-trunks to influence us to make this use of cocaine. However, in amputations during shock this might be tried. Every factor, no matter how small, which aids in lessening the shock is of great value.

**Treatment of Shock.** Crile found the following the most effective : (1) Intravenous infusion<sup>1</sup> of salt solution, which acts mechanically, combined with small and repeated doses of strychnine ; (2) artificial respiration—an increased supply of oxygen is urgently demanded ; (3) external heat ; (4) position of the body head down. One must be careful not to produce an overstimulation ; this is always followed by great depression. The filling of the abdominal cavity, the stomach, or rectum with very hot solution was of doubtful value. In conclusion, Crile states that the *surgical shock is mainly due to impairment or break-down of the vasomotor mechanism.*

### OPERATIVE TECHNIQUE.

In non-traumatic surgery of the extremities, especially arthrotomies and operations on the bone and the opening of tendon-sheaths, the importance of as perfect as possible asepsis cannot be overestimated. Under such conditions the operator can explore joints and the bones with practically no risk of infection.

The absolute asepsis of everything which comes in contact with the wound, except the hands of the surgeon and the skin of the patient, has been accomplished, and there seems to be nothing to be wished for in this direction. There seems, however, still room for improvement in the sterilization of the skin.

**The Use of Rubber Gloves,** if properly employed, has practically solved the question of hand-disinfection. Coley<sup>2</sup> refers to McBurney's<sup>3</sup> article, in which it is stated that his use of gloves dates from October, 1897. Credit for the introduction of rubber gloves, at least in this country, should be given to Halsted. In my monograph on the treatment of hernia,<sup>4</sup> I have given the history of the introduction of rubber gloves at operations in this hospital. In 1889, Prof. Halsted<sup>5</sup> wrote that soon after the opening of the hospital, in June, 1889, rubber gloves were invariably worn by the assistant at the wound who handed sponges, and by the assistant who handed the instruments ; the operator rarely wore gloves, except when clean joints were opened. During the years 1894 to 1896 all of the assistants wore gloves. From December, 1896, the reviewer was the first, as operator, to wear gloves as a routine practice in all clean operations. The effect of the introduction of gloves on the healing of the

<sup>1</sup> Both in Professor Halsted's and Professor Kelly's clinics the salt solution is infused beneath the skin, usually between the breast and pectoral fascia. The method seems as efficacious as the intravenous infusion. It is much more easily done, and can be repeated frequently, and the dangers are practically nil, while in intravenous infusion there are some dangers, especially the introduction of air.

<sup>2</sup> PROGRESSIVE MEDICINE, June, 1899, p. 21.

<sup>3</sup> Annals of Surgery, 1898.

<sup>4</sup> Johns Hopkins Hospital Reports, 1899, vol. vii. p. 304.

<sup>5</sup> Ibid., vol. ii. p. 308.

wound after operation for inguinal hernia is shown by the following figures : 1889 to 1894, 116 cases closed with silk, 28 suppurations, 24.13 per cent. ; 1894 to 1897, 104 cases closed with silver-wire, 10 suppurations, 9.60 per cent. ; 1897 to 1899, 226 cases closed with silver-wire, 4 suppurations, 1.70 per cent.

Rubber gloves were worn by the operator and assistants in the 226 operations from February, 1897, to June, 1899. The four suppurations after operations in which gloves were worn were all late infections and not extensive. Among the previous 38 suppurations, in 11 cases the infection was an acute one, and in each case the staphylococcus pyogenes aureus and albus were found in culture and on cover-slips. The influence of the use of rubber gloves in the prevention of infection of the wound is now appreciated and commented upon by surgeons all over the world, and their introduction has taken place in a large number of the great clinics, especially in Germany. Prof. Fenger, of Chicago, began last year to wear gloves at all operations, and Dr. Richardson and other surgeons in Boston use them.

**The Most Effective Disinfection of the Skin.** This question is not yet settled. Senger<sup>1</sup> read before the last German Surgical Congress a paper on an "Experimental and Clinical Research for Obtaining Sterility of the Skin." Senger demonstrated that the germicidal power of absolute alcohol was *nil*, but that diluted alcohol, although uncertain, has some power ; this power increases with dilution up to from 50 to 40 per cent., and then diminishes. Fifty per cent. alcohol is, therefore, the best solution to use. Alcohol and carbolic acid when used together form an inert chemical combination. Experimentally, a 5 per cent. solution of carbolic acid and absolute alcohol has no germicidal properties ; the dilution of the alcohol gives the mixture some power ; this power increases up to 50 to 40 per cent. ; so that if we use these two substances together the alcohol should be diluted. Senger believes that disinfection is better attained by two or more chemical combinations which in their nascent state have increased germicidal power. In using two or more chemicals for disinfection one should always be familiar with the antiseptic power of the combination.

Senger has found the following method, which is based not only on the chemistry of the combination, but confirmed by bacteriological experiments, of value :

1. A 2 to 5 per cent. solution of hydrochloric acid is applied to the skin for two minutes.
2. This is followed by a 0.5 to 2 per cent. solution of permanganate of potassium for one minute.

<sup>1</sup> Johns Hopkins Hospital Reports, 1899, No. 27.

3. A solution of sulphurous acid is used to remove the discoloration. Water at the ordinary temperature absorbs forty times its volume of sulphurous anhydride and forms a solution of sulphurous acid ( $\text{SO}_2 + \text{H}_2\text{O} = \text{H}_2\text{SO}_3$ ).

These combinations form nascent chlorine, oxygen, and sulphuric acid ( $\text{H}_2\text{SO}_4$ ). The germicidal power is very great, and practically the results are excellent. Whether this combination is better than the combination of permanganate of potassium and oxalic acid I am not prepared to state. We certainly need some more powerful and certain method of hand and skin disinfection. The surgeon's hand frequently, and the patient's skin now and then, may contain most virulent bacteria and their spores, which are not made sterile by the ordinary methods of disinfection. The hands should be just as carefully cleaned, whether gloves are used or not. The gloves may tear or the knife or needle may pierce them.

**The Question of Antisepsis in Recent Wounds, Compound Fractures, etc.** This is by no means settled. I hope next year to be able to discuss the subject and to present some practical conclusions.

Carl von Eicken,<sup>1</sup> writing from the clinic of Prof. Czerny, considers, in an article of thirty-seven pages, the disinfection of infected wounds. Twenty-five references are given to the literature. This publication has been received too late for review, but I should judge that the subject is presented from the stand-point of the German surgeons up to date. The literature begins with the work of Schimmelbusch in 1895.

## INFECTIONS.

**Emphysematous Cellulitis (Gas Bacillus Infection).** Welch and Nuttall<sup>2</sup>, in 1892, were the first to isolate the bacillus which is the cause of gas phlegmon. It was cultivated from the blood and organs of a male mulatto, aged thirty-eight years, who died after the rupture of an aneurism. Regarding the point of entrance they say: "It seems to us that they (the bacilli) entered the aneurismal sac through the external openings in the chest." Rupture had occurred through the chest-wall forty-eight hours before admission. They suggested the name *bacillus aërogenes capsulatus*.

Welch and Flexner,<sup>3</sup> in 1896, say: "To E. Fraenkel belongs the credit of demonstrating the causal relation of the *bacillus aërogenes capsulatus* to the affections called variously gaseous phlegmon, emphysematous cellulitis, or gangrene," etc. Fraenkel,<sup>4</sup> in 1893, published and called

<sup>1</sup> Beiträge zur klinischen Chirurgie, 1899, Band xxiv., Heft 2.

<sup>2</sup> Johns Hopkins Hospital Bulletin, July-August, 1892, vol. iii.

<sup>3</sup> Journal of Experimental Medicine, 1896, vol. i.

<sup>4</sup> Centralbl. f. Bakt., 1893, Band xiii., No. 1.



his isolated bacillus the "bacillus phlegmonous emphysemata," but did not refer to the previous report of Welch and Nuttall in 1892. The bacilli isolated and discovered by these observers are identical (Welch).

Since these publications a number of cases, both of gas bacillus infection of wounds and the presence of the gas bacillus in the blood and organs after death in various infections, have been reported, with careful bacteriological investigations, in which the bacillus *aërogenes capsulatus* of Welch and Nuttall has been isolated.

A sufficient number of surgical cases have been observed to demonstrate the great importance of having always in mind, especially in recent compound fractures, bullet and gunshot wounds, the possibility of a gas bacillus infection. The early recognition and proper treatment in the majority of cases have changed the usual fatal result into a more happy one. I have collected 22 cases of gas bacillus infection (8 from the publication of Welch and Flexner, 3 of which were observed in Halsted's clinic; 6 cases, 1 from each publication, by Love, Wright, Gildersleeve, Erdmon, Norris, and Durham, and 8 unpublished cases from Halsted's clinic, which are to appear in Welch and Flexner's second article, which is not yet published). Of these 22 cases, 13 recovered and 9 died. The infection is one of such importance that I have considered it justifiable to report these cases in detail, and have discussed them under the following groups: Bullet wounds, 3 cases, all recovered; gunshot wounds, 3 cases, 2 recovered; compound fracture, 8 cases, 4 recovered; lacerated wounds, 2 cases, both recovered; phlegmon, 5 cases, 1 recovered. The twenty-second case is a very remarkable one, in which apparently there was infection of a gangrenous leg through the circulation. This patient recovered after amputation.

BULLET WOUNDS (Recovery; Cases I., II., and III.). *Case I.*<sup>1</sup> (Welch and Flexner, Case I., clinic of Professor Halsted.) The reviewer saw this patient a few minutes after his admission to the hospital, on March 29, 1895. He was a healthy boy, thirteen years of age, and had been shot exactly twenty hours before. At that time he was standing, and the bullet before entering the joint pierced his trousers and drawers. There had been no external hemorrhage. The patient was not restless; temperature 101.8°, pulse 105. The wound of entrance was small and was situated on the outer side of the joint 1 cm. below the posterior border of the patella. The knee was kept flexed and was most comfortable when it rested on its outer side. The patient experienced no pain excepting when flexion and extension were attempted. The joint was moderately distended with fluid, and on palpating the joint

<sup>1</sup> Journal of Experimental Medicine, vol. i. p. 25.

and pressing the patella a distinct crepitation was felt. This pressure also expressed a cloudy fluid from the wound of entrance, in which there were a number of air-bubbles. Cover-slips made at once from this fluid demonstrated a few cocci and a large number of bacilli resembling the gas bacillus. There was no œdema of the tissues about the joint; no evidence whatever of infection, except from the microscopical examination of the fluid from the joint and a slight tenderness and pain on motion. Since the accident the wound had received no treatment, nor had it been probed. The gas bacillus and pyogenic cocci having been found in the fluid from the joint, operation was decided upon and performed four hours later (twenty-four hours after the accident).

The bullet had entered the joint and embedded itself in the head of the tibia about 4 cm. below the cartilage. The cavity in the bone was filled with blood-clot; the joint itself contained a small quantity of cloudy fluid slightly blood-stained. The joint and the cavity in the bone, after removal of the bullet, were irrigated thoroughly with a 1:1000 solution of bichloride, and the wound closed. Prof. Welch, who was present at the operation, found in the cover-slips and cultures, both from the fluid in the joint and from the bullet embedded in the head of the tibia, the bacillus *aërogenes capsulatus* (which predominated) and the streptococcus pyogenes. After operation the patient complained of a good deal of pain in the knee, and his temperature gradually rose. In forty-eight hours it was 102.8°, pulse 120, respirations 28. Dr. Halsted then opened the skin incision on the outer side of the knee-joint; the joint was not distended with fluid; the cavity in the head of the bone was filled with apparently normal blood-clot. There was no emphysema of the leg nor gas formation in the bone-cavity or knee-joint. During the next five days the temperature varied from 100° to 102.5°, but on the fifth day rose to 104°. There had been constant complaint of pain in the knee. Third operation, seven days after the first: On examining the joint again it was found filled with a soft material containing masses of blood-clot and small yellow masses. On making incisions into the tissues and muscles of the thigh above the knee-joint there was every evidence of infection. Between the muscles and fascia there was an exudate in which one saw small areas of hemorrhage and yellow areas, and here and there small collections of purulent material. The muscle itself appeared normal. Gas-bubbles were found in the purulent material between the muscles and in the joint-cavity. The limb was amputated at the middle third of the thigh, and the patient made an uninterrupted recovery, remaining in a continuous bath nine days. Fifty days later a secondary amputation was performed. Cultures and cover-slips from the fluid in the joint and exudate between the muscles at the third operation demonstrated the presence of the bacillus *aërogenes capsulatus* and

streptococcus pyogenes, the latter predominating. Cultures and cover-slips from the stump after nine days in the bath demonstrated the presence of only the staphylococcus pyogenes aureus and albus.

*Case II.* (Unpublished, Prof. Halsted's clinic.) Bullet wound of the left arm; incision; bath treatment; recovery. I saw this patient on admission, March 29, 1896, ten hours after the accident. He was a strong, healthy man, aged twenty-seven years, and had been shot with a 45-calibre bullet, which before entering his arm had passed through the saddle blanket and chest of the horse, and his own thick, dirty sweater. The patient stated that he felt a slight smarting pain near the elbow at the time he was hit. He then walked about twenty feet and fainted. In a short time he was able to walk two miles. The hemorrhage was very slight, and on admission his general condition was excellent; temperature 100°, pulse 90; he felt a little chilly. The wound of entrance was above the elbow-joint, and the tissues of the arm about the triceps muscles were slightly indurated and tender. *There was no emphysema.* Nine hours later (nineteen hours after the accident) Dr. Halsted opened the wound. The condition of the arm had changed very little since admission into the hospital. The bullet had entered the posterior surface of the arm above the condyle of the humerus, passed upward twelve inches in the direction of the triceps muscle, and lodged near the shoulder-joint. In the track of the bullet there was a little cloudy and slightly blood-stained material, in which a few gas-bubbles were seen. The tissues in the proximity of the wound were infiltrated with a plastic exudate, in which there were small areas of hemorrhage, but there was *no emphysema.* The wound was completely opened from elbow to shoulder without opening the joints and some of the infiltrated tissue excised. Cover-slips and cultures from the pus and a piece of clothing in the wound demonstrated the gas bacillus (predominating) and the streptococcus pyogenes. The patient remained in the continuous bath twelve days, the wound healing by granulation. Blood-cultures sterile. The gas bacillus disappeared from the bath and wound in five days.

*Case III.* (W. J. Love.<sup>1</sup>) Bullet wound, 44-calibre. The bullet entered the leg three-quarters of an inch below the knee on the outer side, extended downward and forward, and passed out six inches below on the front of the leg, slightly grazing the spine of the tibia. Love saw the patient, a colored man, aged thirty-two years, forty hours after the accident. The leg was swollen, most markedly about the wound of exit; there was emphysema. On pressure, distinct frothy, bloody exudate was expressed from the wound, in which gas-bubbles were seen. The wound of entrance was partly healed, and appeared healthy, but

<sup>1</sup> Medical Record, April 8, 1899, vol. iv.

there was a peculiar fetid odor from the wound. The patient complained of pain; pulse 135, very weak, temperature 102.5°, respiration 28. These symptoms commenced twenty-four hours after the injury, beginning with a chill. Love operated at once, and found the leg distended with a frothy, brownish fluid filled with gas-bubbles emitting a horrible odor. The muscles were soft and macerated and the area of necrosis about the wound was large. It was noted that the bullet had comminuted the head of the tibia and torn the anterior tibial artery. Cover-slip preparations made at once from the fluid in the wound demonstrated a large bacillus. Love states that the next morning the patient was no better, and had pain, restlessness, fever, rapid pulse, and extension of emphysema to the foot. Amputation was refused for some hours, but was finally performed at the upper third of the thigh, sixty-two hours after the injury. The patient was very much collapsed after the operation, but made an uninterrupted recovery. The bacteriological report was made by Dr. C. A. Carey, who demonstrated the presence, both in cover-slips and cultures of the bacillus *aërogenes capsulatus*.

In these three cases of bullet wounds it is to be noted that in Case I. the only foreign body in the joint was the bullet, which was probably the cause of the infection. The gas bacillus and air-bubbles were found to be present on the first examination, twenty hours after the injury. In the second case, in addition to the bullet, the gun-wad and a piece of the clothing were present in the wound. The bacillus, with streptococci and gas, were noted nineteen hours after the injury. In these two cases there was present at the time of the operation no emphysema of the tissues. The infection in the first case was confined to the joint and the cavity at the head of the tibia, and in the second case to the bullet-track. In this case simple incision, followed by a continuous bath treatment, was sufficient to overcome the infection. In the first case the joint was closed at the first operation. The infection, both of the streptococcus and gas bacillus, extended up into the tissues of the thigh, and amputation was necessary on the seventh day. In the third case there was much more infiltration of the tissues, with hemorrhage and a comminuted fracture. In this case, forty hours after the injury, extensive emphysema was present, and although numerous incisions were made, it was found necessary to amputate sixty-two hours after the injury.

GUNSHOT WOUNDS (Cases IV., V., and VI.). *Case IV.* (Unpublished; clinic of Dr. Halsted.) This patient, a strong colored man, aged forty-six years, was admitted December 4, 1898. Twelve hours before his left thigh and some small areas on the right thigh and abdomen had been riddled with No. 4 duck-shot, discharged from a double-barrelled gun at a distance of about forty yards. The wounds had received no treatment, and there had been some oozing of blood from the small but

numerous wounds of the left thigh. There was no emphysema. The anterior surface of the left thigh was riddled with small shot, which apparently entered deeply into the muscles, and there was every evidence that there had been a good deal of extravasation of blood. In pressing blood from the numerous small openings at this time no gas-bubbles were seen. Five hours later the blood expressed from the wounds of the left thigh was frothy with gas-bubbles, and in the cover-slips we found the gas bacilli in great numbers. The operation was performed at once (nineteen hours after the injury). A load of duck-shot was scattered pretty well through the rectus muscle, between the middle third of the thigh and the patella. The tissues were everywhere infiltrated with blood. The collections of blood in the tissues were everywhere fluid and frothy with gas-bubbles, and had a peculiar odor. The muscles were pale and showed evidence of beginning necrosis. The knee-joint contained blood-stained fluid, but no gas-bubbles. The operation consisted of free incisions, with excision of the greater part of the rectus muscle and the opening of the joint. The patient was placed in a continuous bath. Recovery was uninterrupted up to about the twenty-fifth day, when there was evidence of a secondary infection of the granulating wound with the streptococcus pyogenes. Death from general infection occurred five days later. The cultures and cover-slips from the frothy blood and from the tissues at the first operation by Dr. Clopton demonstrated the bacillus *aërogenes capsulatus* (the predominating organism) and the staphylococcus *pyogenes albus*. The gas bacillus was found to be present in the wound and bath for about six days after the operation. The streptococcus was a distinct secondary infection.

*Case V.* (Recent ; unpublished ; Prof. Halsted's clinic.) A strong man, aged twenty-one years, who about three hours before admission was accidentally shot with a double-barrelled shot-gun, was admitted May 28, 1899. The barrels were so close to the limb that the charge made a large, ragged, open wound in the posterior surface of the thigh, from which there was very little hemorrhage. Gas bacilli were found in pure culture from the wound twenty-four hours after the accident. There was, however, no emphysema of the tissues about the wound. Later, the wound became infected with the streptococcus pyogenes, but the gas bacilli had disappeared. The patient recovered.

*Case VI.* (Unpublished ; Prof. Halsted's clinic.) Gunshot wound of the back. This patient, a strong colored man, was admitted to the hospital February 1, 1899. Thirty-six hours before admission he was accidentally injured. The shot-gun when it was discharged was about four feet from the patient, and the contents lodged in the right flank. On admission there was a large, open wound in the right lumbar region, exposing the kidney and the diaphragm. Twenty hours later the gas bacillus was

found in the wound along with other pyogenic cocci. This patient died on the seventeenth day, but up to the time of death no emphysema was noted in the tissues about the wound. At the autopsy it was found that there was extensive laceration of the kidney, the right lobe of the liver, the diaphragm, and lower right lobe of the lung. The wound was filled with macerated tissue containing beside the gas bacillus other bacilli and pyogenic cocci. The liver, lung, and kidney adjacent to the wound were emphysematous. Cultures from the blood demonstrated the gas bacillus, the colon and pyogenic cocci, but on opening the veins no gas was observed. The spleen, however, was emphysematous, and the cultures demonstrated the presence of the gas bacillus. In this case cultures made from the blood before death were sterile.

In Case V. the presence of the gas bacillus in pure culture from the much lacerated wound, twenty-four hours after the accident, is of interest in demonstrating that when the wound is opened and left open the danger of infection from this organism is not great. Case IV. is a very interesting one from a diagnostic stand-point. Its symptoms resemble very much those of Cases I. and II. of bullet wound. The patient was perfectly comfortable, with a good pulse and a temperature of but 101°; yet from the numerous holes in the thigh made by the shot, frothy blood was found twenty hours after the injury, and the gas bacillus in great numbers in cover-slips. In this case the free incisions, followed by the continuous bath treatment, completely checked the emphysematous cellulitis. The patient was making an uninterrupted recovery, and death, which took place on the seventeenth day, was due entirely to a secondary virulent streptococcus infection of the large granulating wound in a patient who was much depressed by a previous infection. In Case VI. the wound itself was such a severe one, and the infection was so mixed, that death cannot be entirely attributed to the gas bacillus, although it had produced emphysema in the kidney, liver, and lung about the wound, and the gas bacillus had been present in the blood and produced emphysema of the spleen.

COMPOUND FRACTURES; RECOVERY (Cases VII., VIII., IX., and X.). *Case VII.* (Welch and Flexner, Case II., Halsted's clinic.) Compound fracture of the leg; amputation; recovery. A strong, healthy man, aged twenty years, who six hours before admission had had the left leg crushed in a railroad accident. The amputation had been performed at the site of the railroad accident, and there had been no aseptic precautions. On admission the patient's general condition was good. The stump was found to be distended with blood. For this reason the patient was anesthetized and the Esmarch bandage placed on the thigh; the wound was opened, the blood-clot turned out and two vessels tied. There were no gas-bubbles and no evidence

of infection. The wound was thoroughly irrigated with 16 litres of a 1:1000 bichloride solution. The skin was then partly closed with a small gauze drain. Cultures were not taken. The patient was perfectly comfortable for about five hours after his admission to the hospital—that is, from twelve to fourteen hours after the accident. He then complained of feeling chilly and of intense pain and heat in the amputated stump. Temperature in a few hours rose rapidly from 101° to 104°, with a pulse from 110 to 150. When I saw the patient his face was flushed, and he complained so intensely of pain in the stump (stating that he felt it would burst) that before it was examined he was placed under primary anaesthesia. On exposing the stump emphysema was present beneath the skin on the anterior and lateral surfaces, extending to a position 1 cm. above the patella. Beginning at the skin-edges of the flaps there were a number of red, irregular lines of lymphangitis extending up to the knee. The subcutaneous tissue was slightly cedematous. The wound was opened and found to contain a blood-stained serum, but no gas-bubbles. Cover-slips made from this blood and examined at once by the bedside demonstrated great numbers of a large bacillus, many free and many in the leucocytes. A number of the white blood-corpuscles contained some four or five bacilli, also a few cocci. A longitudinal incision was made through the skin and subcutaneous tissue, to demonstrate the extent of the infection upward. In the areolar tissue between the skin and the aponeurosis of the muscles, and between the muscles and the periosteum of the tibia, there was a fresh exudate of fibrin gluing the tissues together. In this exudate there were numerous areas of hemorrhage and here and there gas-bubbles. The infiltration of the tissue with gas-bubbles extended at least 3 cm. beyond the hemorrhagic exudate. There were no distinct areas of purulent material to be made out. Cover-slip preparations from the exudate demonstrated numerous leucocytes, red blood-cells, and the gas bacillus, *but no other organism*. The demonstration of the presence of the gas bacillus in the blood from the wound and in the exudate of the emphysematous area took but a few moments. With this finding I amputated the leg above the knee beyond the area of emphysema, and placed the patient immediately in a continuous bath, where he remained for seven days. The convalescence was uninterrupted. Cultures and animal experiments demonstrated the bacillus *aërogenes capsulatus* and the staphylococcus *pyogenes albus*. Cultures from the granulating stump after three days in the bath were negative for the gas bacillus. There was no further emphysema after operation.

*Case VIII.* (Case V., Welch and Flexner.) A patient of Dr. Tiffany, of Baltimore, suffered a compound fracture of the right forearm, and was admitted ten hours after the accident. The tissues were much lacerated and contused, and an attempt was made to save the limb. Thirty-three

hours after the injury emphysematous crackling was noticed above the wrist, and the tissues were becoming œdematous. Two hours later—that is, thirty-five hours after the accident—the arm was amputated between the shoulder and elbow. The patient made a good recovery. Cover-slip preparations and cultures demonstrated the *bacillus aërogenes capsulatus* and pyogenic cocci, and also a spore-producing anaërobic bacillus, which was lost.

*Case IX.* (W. Southey Wright.<sup>1</sup>) A girl, ten years of age, on May 25, 1898, suffered a compound fracture of both bones of the upper forearm. Dr. Wright saw the patient thirty minutes after the accident. The wound was not bleeding, although the clothes were soaked with blood. Both bones projected. The wound was washed with a carbolic solution and covered with antiseptic dressings; the arm was placed in a splint after the reduction of the fragments. On the following morning (the number of hours not stated) Dr. Wright found that the patient had passed a very bad night; temperature 102°, rapid pulse, slight delirium. The dressings were removed and the arm appeared to be in good condition. At 9 P.M., over twenty-four hours after the accident, Dr. Wright found the patient in marked delirium, and the dressings were soaked with a thin, bad-smelling discharge. The edges of the wound were slightly ashy in color. The wound was again dressed and the fracture again fixed in splints. The next morning, forty-eight hours after the accident, the hand and wrist were cold and black, and there was emphysema below the wound. Above the area of gangrene and emphysema the arm was swollen, and there was a dusky redness of the skin extending up almost to the shoulder. Six or eight hours later amputation was performed by Mr. Tubby—that is, about sixty hours after the accident. Amputation was performed about the middle third of the arm, and the wound loosely closed. The patient recovered. The infection was attributed to the bacillus of malignant œdema, but no complete bacteriological report was made.

*Case X.* (Gildersleeve.<sup>2</sup>) This patient, seen in consultation with Dr. Hill and Dr. Petit, was a boy, ten years of age, who was injured forty-eight hours previous to the consultation. The injury was a compound fracture of the right forearm. The bones had protruded and come in contact with mud. A few hours later, under an anæsthetic, the fracture was reduced and a splint applied. No discomfort was felt until the morning of the second day (about thirty-six hours), when the boy began to complain of pain, and early in the afternoon of the same day the forearm began to swell and emphysema and beginning gangrene were

<sup>1</sup> London Lancet, August 13, 1898, vol. ii.

<sup>2</sup> Medical Record, March 4, 1899, vol. lv., No. 9.



observed. At the time of the consultation, a few hours after the onset of these symptoms, the gangrene had extended to an inch above the elbow-joint. The hand and forearm were greatly swollen and emphysematous. Above the line of demarcation the integument was of a dusky hue, extending up to the shoulder-joint. An emphysematous crepitation could be distinctly felt over the scapula behind and beneath the clavicle in front (the emphysema had then extended far beyond the line of gangrene). The patient was at once anæsthetized and several long incisions were made through the forearm and along the back of the hand. Dr. Gildersleeve remarks that "as each incision was made the force of the escaping gas was sufficient actually to blow the dead muscular tissue out of the wound." The arm was dressed in gauze soaked in antiseptic solution. There seemed to be some improvement in the local condition, but this ceased at the end of three days. On the fourth day Dr. Gildersleeve amputated the arm at the junction of the middle and upper third, leaving the wound open. The patient recovered. There is no bacteriological report.

COMPOUND FRACTURE; DEATH (Cases XI., XII., XIII., and XIV.).  
*Case XI.* (Unpublished; Halsted's clinic.) Compound fracture of the femur, with great laceration and contusion of the soft parts. This patient, a male, aged sixty years, was seen by Dr. Finney ten hours after the accident, and on account of the extent of the injury, amputation was advised but refused. The patient was admitted to the hospital twenty-two hours after the accident, and again refused amputation. The wound had been carefully cleaned by Dr. Finney and again on admission to the hospital, and it had been left wide open. There was, however, evident necrosis of the muscles. Forty-eight hours after the injury the gas bacillus was found in cover-slips in the wound, but there was no emphysema. The local and general condition rapidly became worse. The patient consented to amputation on the fourth day, but he was in collapse at that time, and died fifteen hours later. On examining the removed limb we were able to find the gas bacillus in cover-slips only a short distance beyond the gangrenous tissue. There was no evidence of osteomyelitis of the fractured bone. There was a little emphysema at the junction between the necrotic and slightly infiltrated tissue.

*Case XII.* (Welch and Flexner, Case IV.) This patient was under the care of Prof. Tiffany, of Baltimore, and the cultures and cover-slips were made by Dr. Mann. Male, aged twenty-seven years; compound comminuted fracture of the patella; wound infected by the clothing. No loss of blood, no shock. One and a half hours after the injury Dr. Tiffany opened the joint, removed some fragments of the patella and stitched the capsule. The patient very rapidly became delirious, and there was fever and rapid pulse. Death took place within forty-eight

hours after the injury. Emphysema was detected by the resident physician a few hours, and by Dr. Tiffany a few moments, before death. This emphysema extended about three inches above the fractured patella and below, and the tissues were œdematous. On making an incision a red-dish serous exudate containing gas-bubbles escaped; there was no pus. No autopsy.

*Case XIII.* (Erdmon;<sup>1</sup> also reported by Durham.<sup>2</sup>) Patient seven years old; compound fracture of the right humerus, middle third, and a scalp wound. Seen by Dr. Erdmon in two hours. The tissues were dirty and contused. The wound was dressed with every antiseptic and aseptic precaution. The patient remained unconscious, probably from the head injury. The fever and rapidity of the pulse gradually increased. Within forty-eight hours, when the dressings were removed, the arm and the pectoral region of the right side were swollen, the skin was œdematous and of a greenish-brown color, and on making an incision a peculiar brownish fluid with a slight odor escaped. Erdmon considered amputation inadvisable, on account of the involvement of the tissues of the chest-wall, but made free incisions. The œdema extended to the posterior part of the chest and down the forearm, and some emphysema was noticed. Death took place three days after the injury and twenty-four hours after the onset of the symptoms of infection. The cultures were carefully worked out by Durham, who made his report in the *Johns Hopkins Hospital Bulletin*.

*Case XIV.* (Norris.<sup>3</sup>) The patient was under the care of Dr. Bryant, of New York, and the case is also reported by Erdmon. The injury was produced by the wheel of a heavy truck passing over the right leg, which caused a compound fracture of the tibia in the upper third, with much contusion and extravasation of blood. On admission the leg was much swollen, ecchymotic, and there were signs of air under the skin below the tuberosity of the tibia. The knee-joint seemed to be full of air and fluid. The patient was in shock and the foot was cold. The operation consisted in opening the wound and thoroughly washing it out with bichloride solution. In forty-eight hours the temperature gradually rose to 104°; the patient was restless, the leg was greatly swollen, and on making incisions a large quantity of offensively smelling fluid blood flowed out. The wound was irrigated frequently with carbolic acid and kept in hot carbolic dressing. The temperature continued to rise and the condition to grow worse. An anæsthetic was given, and on making further incision gas was noted in the tissues (emphysema had not been noted before). The incisions were carried up into the thigh

<sup>1</sup> Medical News, October 9, 1899, vol. lxxi.

<sup>2</sup> Johns Hopkins Hospital Bulletin, April, 1897, vol. viii.

<sup>3</sup> American Journal of the Medical Sciences, February, 1899, vol. cxvii., No. 2.

and drainage-tubes were inserted. On the sixth day the limb was amputated at the lower third of the femur. The patient died five days later. Cultures made by Dr. Norris demonstrated the presence of the *bacillus lacteus aërogenes*.

**COMPOUND FRACTURE; RECOVERY.** The four cases of compound fracture which recovered should be contrasted with the four cases which died. In the former amputation was performed between the fourteenth and fifty-fourth hour after the accident. In Cases VIII., IX., and X. the extent of the injury to the soft parts and the emphysema were as marked as in the cases which died, but the earlier amputation saved life. Case VII. is the most interesting one of this group. It demonstrates a definite infection with the gas bacillus following operation, the only example in the twenty-two cases. Here we have an amputation for a railroad crush performed a few hours after the accident without any antiseptic precautions. Six hours later the wound was opened for hemorrhage and thoroughly irrigated. There was no evidence whatever at that time of infection, nor any laceration of the tissues; the circulation both of the skin and muscle at every point seemed perfect. Yet six hours later, with the acute onset of high fever, intense pain, rapid pulse and respiration, the symptoms of a virulent infection took place. And on examining the wound nothing was found but a little serum beneath the flaps, containing gas bacilli and cocci (*staphylococcus pyogenes albus*), and very slight and not extensive emphysema of the subcutaneous tissues.

**COMPOUND FRACTURE; DEATH (Cases XI., XII., XIII., and XIV.).** In one case, although the patient was carefully treated antiseptically two hours after the accident, and had symptoms of infection twenty-two hours after the accident, and although the gas bacillus was found in forty-eight hours, amputation was not performed for ninety-six hours. In Case XIV., although the wound was opened by free incision forty hours after the accident, amputation was not performed until the sixth day, and death took place on the eleventh day.

Case XII. is of especial interest, because the wound about the knee-joint was thoroughly cleaned an hour and a half after the accident. The rapidity of the symptoms and of emphysema were more marked than in any other case, and death took place forty-eight hours after the accident; no operation was performed.

In Case XIII., although the wound was dressed carefully two hours after the accident, the symptoms of infection and emphysema were rapid; amputation, however, was not performed, on account of the involvement of the tissues above the shoulder. Death took place forty-eight hours after the accident. This case should be compared with Case IX., in which recovery followed amputation, although the emphysema had extended up and beyond the point of amputation.

RECENT LACERATED WOUNDS (Cases XV. and XVI.). *Case XV.* (Unpublished case; Halsted's clinic.) Admitted December 3, 1898, with a large lacerated wound over the right scapula. The skin and muscles were torn, exposing the bone, but there was no fracture. Very little loss of blood; no shock. The wound within a few hours after the injury was thoroughly cleaned with 1:1000 bichloride, and swabbed out with pure carbolic. It was left open and irrigated twice a day for forty-eight hours. At this time there was no fever and no appearance of infection. Some of the muscular tissue lining the wound was slightly necrotic. At the operation the necrotic tissue was excised; the wound closed. Ten hours after the operation the temperature rose suddenly to 104°; the patient was restless and complained of pain in the wound. The wound, opened at once, contained a little blood-stained serum; the skin edges were slightly œdematous, but no emphysema nor gas was present. Cover-slip preparations made at once showed numerous large bacilli and streptococci. Cultures by Dr. Clopton demonstrated the streptococcus, the gas bacillus, and two unidentified bacilli. The wound was left open and the patient put in a continuous bath. Convalescence was uninterrupted. Gas in the discharge or emphysema were never noticed.

*Case XVI.* (Unpublished case; Halsted's clinic.) Lacerated wound of the scrotum. Admitted twelve hours after the accident. There was a good deal of hemorrhage, and the wound had been dressed with a dirty rag, and later sutured with interrupted silk. About four hours after admission (sixteen hours after the accident) the temperature rose to 103.8°. It was noticed that the scrotum was red and œdematous, and there was a slightly bloody discharge from the loosely approximated wound. Cover-slip examination from this fluid showed numerous leucocytes and many large bacilli with the morphology of the gas bacillus. The wound was opened and left open, and the patient made an uninterrupted recovery. The wound healed by granulation after the separation of a small area of necrotic skin of the scrotum; no emphysema was noted.

These two cases (XV. and XVI.) are of interest. In Case XV. the open wound was thoroughly disinfected, even with pure carbolic. It should be remembered, however, that there was a good deal of destruction of the muscle. When this necrotic tissue was excised forty-eight hours later, and the wound thoroughly cleaned and closed, the symptoms of infection began at once. These symptoms were relieved the moment the wound was opened again, although myriads of gas bacilli and pyogenic cocci were present, demonstrating how virulent these bacteria are when the wound is closed and how harmless, frequently, when the wound is left open. Case XVI. is similar. Here the symptoms of infection

were immediately relieved when the sutures were cut and the wound left open, although gas bacilli in great numbers were found in the cover-slips, as well as a few pyogenic cocci.

**EMPHYSEMATOUS PHLEGMON OR CELLULITIS (Cases XVII., XVIII., XIX., XX., and XXI.).** *Case XVII.* (Welch and Flexner, Case VI.) Patient of Dr. Mann; female, aged seventy-four years. When first seen the hand, forearm, and arm were much swollen, with red lines extending to the elbow. The hand itself was gangrenous, with blebs containing bloody, offensively smelling fluid. Emphysema was present as far as the deltoid muscle. General condition bad; amputation was performed at the insertion of the deltoid muscle, and examination of the amputated arm showed that the tissues were disorganized and infiltrated with an offensive bloody exudate, in which gas-bubbles were plentiful. The patient's general condition improved and the emphysema of the tissues above the line of amputation disappeared. On the fourth day symptoms of *tetanus* appeared, and death took place two days later; no autopsy. Cultures and cover-slips showed streptococci and the bacillus *aërogenes capsulatus* fully identified. From the wound after amputation, no gas bacillus.

*Case XVIII.* (Durham.<sup>1</sup>) The patient, a woman, aged twenty-three years, was admitted with a swelling beneath the left lower jaw, which began three days before admission. The teeth on that side were decayed. The swelling of the neck rapidly increased, and was associated with fever and difficulty in swallowing and breathing. On account of the difficulty in swallowing and breathing the patient was intubated on the third day, and some hours later an incision was made into the swelling of the neck. Emphysema had never been noted, but there was marked oedema. The pus did not contain gas. Some fourteen hours after the incision emphysema was noted at the angle of the jaw. The patient died four days after admission, seven days after the onset. Cultures and cover-slips examined by Durham demonstrated the presence of the bacillus *aërogenes capsulatus* and the staphylococcus *pyogenes aureus* and *albus*. There was no autopsy. The case was considered clinically to be one of anthrax infection.

*Case XIX.* (Mentioned by Welch and Flexner, p. 20.) A patient of Dr. Mann, from the clinic of Prof. Tiffany. The affection began as a small, black blister on the palmar surface near the end of the left ring finger. The entire hand rapidly became swollen and oedematous, and emphysema was present up to the wrist. There was high fever and a rapid pulse. Free incisions were made and the hand placed in a hot bichloride bath. Recovery took place, with the loss of the middle finger

<sup>1</sup> Johns Hopkins Hospital Bulletin, 1897, vol. viii.

from gangrene. Cultures by Mann demonstrated the streptococcus pyogenes and the bacillus *aërogenes capsulatus*.

*Case XX.* (Mentioned by Welch and Flexner, p. 22.) *Case of Passow.* Three weeks after superficial wound of the hand, which healed slowly by suppuration, the patient developed septicæmia, and a few days later an emphysematous swelling over the right shoulder-joint, extending down the arm. The joint was incised; the fluid was brownish and contained gas, and there was an odor of sulphuretted hydrogen. Death three days later. Gas was not found in the blood or internal organs. Passow identified the bacillus with Fraenkel's bacillus of gaseous phlegmon.

*Case XXI.* (Welch and Flexner, Case III., clinic of Dr. Halsted.) A male, aged thirty-five years, eight days before admission, suffered from a contusion over the right buttocks and thigh, and five days later came to the dispensary complaining of pain and tenderness along the sciatic nerve. There was no external evidence of infection at that time. He was treated for sciatica. He was admitted to the surgical ward on the eighth day. Temperature 101°, pulse 85. Swelling of the posterior upper two-thirds of the thigh, with tenderness, was present, but there was no emphysema. The skin at this time was not red nor oedematous, but the deeper tissues were infiltrated. There was no involvement of the joints. On rectal examination there was a distinct fulness and tenderness on the right side of the rectum 4 cm. above the sphincter. Eight hours later emphysema was noted for the first time in the popliteal space. At the operation an incision was made from the popliteal space to the tuberosity of the ischium. It was clearly demonstrated that the pus, which was filled with gas-bubbles, came from the pelvis through the great sacro-sciatic foramen. There was definite emphysema of the tissues and purulent material containing gas-bubbles. The muscles were infiltrated and matted together by fresh exudate. The emphysematous condition extended down toward the foot. At the operation and at the autopsy the gas bacilli and other bacteria were found in the wound. At the autopsy (by Flexner) gas bacilli were found in the lungs, but not in the blood or other organs. The autopsy demonstrated that the infection began in the perirectal tissue within the pelvis on the right side. At this position in the rectum of the right side there were two perforations. The infection extended along the rectum into the ischial rectal fossa and from the pelvis along the great sciatic nerve.

**GAS BACILLUS INFECTION IN A CASE OF GANGRENE FOLLOWING LIGATION OF AN ARTERY.** *Case XXII.* (Unpublished; Halsted's clinic.) Male, aged thirty-four years. Ligation of the femoral artery in Hunter's canal for an arterial venous aneurism in the popliteal space. Gangrene of the foot and leg, extending to a position about 4 cm. below the knee, began at once. The patient suffered severely from pain. On the

tenth day there was a sudden rise of temperature to 105°. For this reason amputation was performed at once. The leg was first removed above the line of demarcation. The operator (Bloodgood) noticing an oedematous condition of the muscles, but no gas-bubbles, had cover-slips made immediately, and these showed great numbers of bacilli. Later, a few gas-bubbles were found between the muscles. The aneurismal sac in the popliteal space was incised and contained both clotted and fluid blood and a few gas-bubbles, and cover-slips demonstrated the presence of the gas bacillus in great numbers. The demonstration of the presence of the gas and bacilli in the tissue and in the aneurismal sac was an indication for amputation of the thigh, which was done at the middle third, and the patient placed in a continuous bath. Convalescence uninterrupted. It is interesting to note that when the second amputation was done for the granulating stump, two months after the first amputation, in a small subcutaneous abscess, the gas bacilli were found (by Cushing), although there was no gas and no emphysema.

*Emphysematous Phlegmon* (in Case XVII.). The time of the onset of the infection is not given, but the entire arm was emphysematous, and it appeared as if the infection began somewhere in the fingers or hand. In this case it appears as if recovery would have taken place if infection by tetanus had not also been present, which seemed to be the cause of death. In Case XVIII. it would appear that if the operation had been performed when the patient was first seen, three days after the beginning of the infection, rather than three days later, recovery would have followed. The portal of entrance in this case seemed to be from the mouth through the carious teeth. Case XIX. was a definite emphysematous cellulitis, beginning from a small blister in the palm of the hand. It is not noted how long after the beginning of the infection the free incisions were made. Recovery in this case, however, followed without amputation. Case XX. represents the only one where we have an infected wound with a metastatic arthritis of a neighboring joint. The gas bacillus infection was probably secondary, as the joint symptoms did not begin until three weeks after the wound of the hand. In this case amputation was not done, but simple incision of the joint. A rapid amputation at the shoulder-joint might have given a different result. In Case XXI. the cause, position, and the portal of entrance of the infection were difficult to make out before operation. The patient was not seen until the eighth day, and although free incisions were made, death took place. In this case, unquestionably, the gas bacillus entered the tissues of the pelvis from the rupture of the rectum.

Case XXII. is unique. I observed this case throughout. Here we have gangrene following ligation of the femoral artery. There was no wound on the skin over the gangrenous leg, and the healing of the wound

on the thigh, through which the artery was ligated, showed no evidence of infection; yet on the tenth day there was a sudden rise of temperature, and the gangrenous leg showed beginning oedema. The gas bacillus in pure culture was found in the tissues of the leg, not only in the area of gangrene, but above it and in the sac of the aneurism, along with gas-bubbles, but not in the wound. The operation was performed a few hours after the beginning of the infection, and recovery followed.

Unquestionably, in gas bacillus infections an early diagnosis is always possible and not at all difficult. In any recent wound with symptoms of infection one should at once make cover-slips from the fluid in the wound. The presence of large bacilli, morphologically like the gas bacillus, even with the absence of gas-bubbles or emphysema, is practically in the majority of cases pathognomonic of a gas bacillus infection. If one finds, in addition, air-bubbles in the fluid or emphysema of the tissues, plus the presence of bacilli in cover-slips, there is practically no question about the diagnosis. If the infection is recognized early, and the destruction of the soft parts and bone is not extensive, free incisions with immediate continuous bath treatment should be tried. If the general symptoms of infection are not immediately relieved amputation should be done. If, however, the infection is recognized late one should take no risk, but amputate at once. The bacilli present are usually so numerous, at least they have been so in the eleven cases which we have observed in Halsted's clinic, that a cover-slip preparation from the tissues will always demonstrate the extent of the gas bacillus infection.

*The Indication for a Higher Amputation in Case XXII.* Had I not found the bacilli on a cover-slip preparation in the sac of the aneurism there would have been no indication for an amputation above the knee; but looking for it there at the time of the operation probably saved the patient's life. A lower amputation, leaving the large aneurismal sac in the popliteal space already infected with gas bacilli, would probably have led to further extension, and perhaps, before it was recognized, a second amputation would have been too late.

Clinically, the subject of gas phlegmon seems settled. An early diagnosis will probably save life, and from many observations an amputation may not always be necessary. The etiology is not yet settled, however, and this is a study in pure bacteriology. A number of anaërobic bacilli and a few aërobic may be isolated.

**The Bacillus Aërogenes Capsulatus in the Blood During Life.** N. B. Gwyn<sup>1</sup> is the first to cultivate this bacillus from the circulation during life. Previous observers have never been able to find the bacillus in the blood except at autopsy, but Welch and others thought that the bacillus entered the circulation before death.

<sup>1</sup> Johns Hopkins Hospital Bulletin, July, 1899.



Clark,<sup>1</sup> in discussing emphysema of the abdominal parietes following laparotomy, mentions in detail the case observed by me in Dr. Halsted's clinic, in which the gas formation was due to the bacillus of Welch and Nuttall. The portal of entrance was probably from the appendix, which had been removed between attacks. Emphysema following laparotomy, excision of tumors in the neck, and operations on the chest in which the pleura or lung are injured, even simple aspiration, is not uncommon. Although so far only the case mentioned by Clark has been observed to be due to the gas bacillus, yet surgeons should always bear in mind this possibility, especially after laparotomies in which the intestine has been opened. The bacillus *aërogenes capsulatus* is not an uncommon habitat of this part of the body. Clopton (personal communication, Johns Hopkins Hospital) has lately found the bacilli twice in the appendix. Simple emphysema and gas phlegmons are, I believe, easily to be differentiated; in the latter oedema and tenderness are present. However, a cover-slip and culture examination should always be made from the wound.

Dobbin (personal communication, Johns Hopkins Hospital) observed gas phlegmon following the infusion of salt solution beneath the breast. The infusion had to be rapidly performed in the very uncleanly home of the patient, who was in collapse from a hemorrhage following parturition. No precautions could be taken. Recovery, however, followed incision. Cultures demonstrated an anaërobic bacillus, which was carefully worked out on the various media and observed extensively with animal inoculations. The bacillus, with few exceptions, was identical with that described by Welch and Nuttall.

### ORIENTAL SORE OR DELHI BOIL.

Kipling's<sup>2</sup> description of this deformity: "Her face was as white as bone, and in the centre of her forehead was a big silvery scar, about the size of a shilling—the mark of a Delhi sore which is the same as a 'Bagdad date.' This comes from drinking bad water, and slowly eats into the flesh till it is ripe enough to be burnt out," may be confirmed by observations on the soldiers returning from our foreign tropical possessions. German surgeons have lately seen this local infection among some of the members of the Emperor's suite after their return from Palestine, and French surgeons in soldiers after their return from Tunis. English surgeons, because of their wide tropical experience, are very familiar with the oriental sore, and Makins gives us an excellent description in Treves' *System of Surgery*.

<sup>1</sup> PROGRESSIVE MEDICINE, vol. ii., 1899, p. 226.

<sup>2</sup> The Day's Work—William the Conqueror.

Loewenhardt,<sup>1</sup> before the Twenty-eighth German Surgical Congress, reported three cases. The etiology is not yet established. It is a distinct local infection, with a varying period of incubation—usually a number of months. It is highly contagious and auto-inoculable, and first appears as a red papule on the exposed parts of the body; this papule slowly enlarges and is covered with a scab. Central necrosis follows and the suppuration is profuse. Healing takes place slowly. The surrounding skin may become secondarily infected with the formation of a number of boils, and the resulting scar is often a great deformity. An early complete excision, I think, would lead to a quicker cure, with less deformity. The English surgeons are apt to wait for suppuration and then to cauterize. American surgeons in the Philippine Islands and those at home may have an opportunity to demonstrate the cause of this infection.

### MADURA FOOT (MYCETOMA.)

James R. Wright<sup>2</sup> reports a very interesting case, with excellent plates, both of the gross specimen and microscopical section, and of cultures. The most important feature of this article is that Wright has been able to cultivate the fungus from the melanoid granules. He states that "From a consideration of the results of this list of observers it is quite evident that the disease known as *mycetoma* is due to two different organisms—in other words, that the black granules of the melanoid form are composed of an organism entirely different from the organism or organisms making up the pale or orchroid granules," and that "There can be little doubt that the melanoid granules are composed essentially of a fungus or a hypomycete, and that probably one and the same fungus has been seen by other observers. The chief thing lacking in these studies of the melanoid granules has been the growing of the fungus. The cultivation has been accomplished in a case reported below."

*Clinical History.* The patient was an Italian woman, twenty-six years of age, who was admitted to the Massachusetts General Hospital in December, 1897. It is interesting to note that when first seen in the out-patient department by Dr. C. A. Porter, the condition of a probable Madura foot was suggested by him. The disease was situated at the base of the second and third toes on the plantar surface. There were swelling and desquamation of the epithelium, and there was present a small sinus, from which could be expressed a dirty, greenish fluid. The characteristic observation, however, was the recognition of black, hard, irregular granules, like grains of gunpowder, in this fluid. On the dorsum

<sup>1</sup> Centralblatt für Chirurgie, 1899, No. 27.

<sup>2</sup> Journal of Experimental Medicine, 1898, vol. iii.

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# PLATE I.

FIG. 1.



FIG. 2.



FIG. 3.

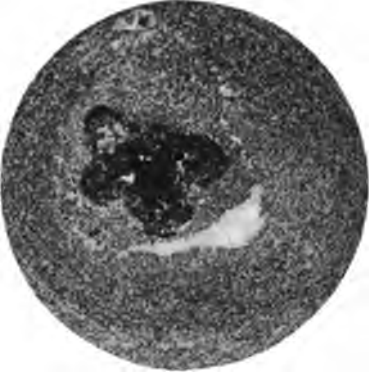


FIG. 4.

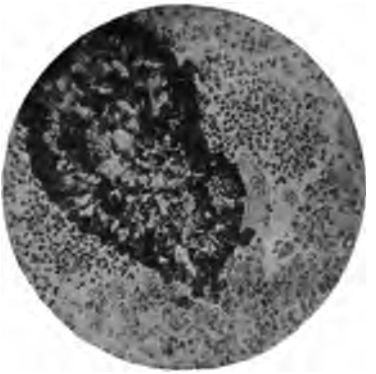


FIG. 5.

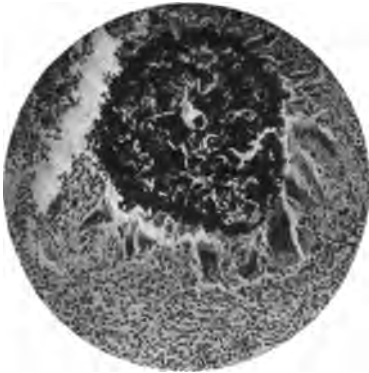


FIG. 6.



Fig. 1.—Portion of the amputated part, showing the black granules and general character of the lesions as seen with naked eye.

Fig. 2.—Section showing black granules and general features of the lesions as they appear under a low magnifying power—Zeiss a<sub>1</sub>.

Figs. 3, 4 5, 6.—Sections showing the granules and surrounding cells. All, with the exception of Fig. 4, taken with Zeiss apochromat. 16 mm. Fig. 4 taken with Zeiss apochromat. 4 mm. Figs. 5 and 6 represent the tubercle-like nodules with the parasite in the centre. (WRIGHT.)



FIG. 1

## PLATE II.

FIG. 2.



FIG. 3.

FIG. 4.



FIG. 5.

FIG. 6.



Fig. 1.—Fungus elements from a granule after bleaching and softening with sodium hypochlorite solution. A branching, septate hypha is shown. Zeiss apochromat. 4 mm.

Fig. 2.—Section showing margin of two contiguous granules, highly magnified. Zeiss apochromat. 2 mm. The small clearer areas represent fungoid elements. The darker substance represents the hyaline embedding substance.

Fig. 3.—Black granule, with mycelial growth proceeding from it. Zeiss  $a_2$ . Culture in bouillon.

Fig. 4.—Showing structure and appearances of the hyphae of the mycelium obtained from the granules. Zeiss apochromat. 4 mm.

Fig. 5.—Two bouillon cultures showing the powder-puff ball appearance. (In one of the black granules is seen the centre of the growth.)

Fig. 6.—Potato culture of the hyphomycete obtained from the granules. The black globules are composed of a dark-brown fluid. (WRIGHT.)

of the second toe there was a small ulcer. The disease had been present about six months. A piece was excised for microscopical examination, but the black granules were the most diagnostic point. It was considered a case of Madura foot of the melanoid variety, and amputation was performed of four toes, together with the four corresponding metatarsal bones.

Wright gives a most careful gross and microscopical description of the appearance of the disease (Plate I.). In Fig. 1 the jet-black melanoid granules in the granulation tissue are plainly seen, and in Fig. 2 the same granules in microscopical section. Figs. 3, 4, 5, and 6 are sections of the granules themselves with the higher power. Tubercle-like nodules with the parasite in the centre (Plate II.) are also seen. Fig. 1 shows the fungus from the granule after bleaching and softening with sodium hydrochloride solution. Fig. 2 shows the margin of two contiguous granules highly magnified. The small, clearer areas represent the fungus elements; the darker substance the hyaline embedding substance; Fig. 3, the black granules with mycelial growth proceeding from it; Fig. 4, the structure and appearance of the hyphæ of the mycelium obtained from the granules; Fig. 5, two bouillon cultures, showing the powder-puff-ball appearance, and in one the black granule is seen in the centre of the growth. Fig. 6 is a potato culture obtained from the granules. The black globules seen are composed of dark brown fluid.

The importance of this observation, then, is the isolation and cultivation of the fungus producing the black granules in the melanoid variety of Madura foot. Wright goes into the literature, especially of the three undoubted cases which have been reported in this country.

Dr. Porter is to be congratulated on recognizing the disease from its gross appearance. Although Madura foot is endemic in India and not uncommon in Africa and Italy and other tropical and sub-tropical countries, and supposed to be very rare in this country, nevertheless if we are more alert the number of these interesting cases will, perhaps, increase in this country.<sup>1</sup>

## AMPUTATION.

**When to Amputate.** To estimate the mortality of amputation a great number of details must be considered. In a great number of cases the chief question is not *how*, but *when*, to amputate. In the recently injured the question of amputation during shock is a most important one. If there is little or no shock the mortality of an amputation is practically *nil*. When the patient has lost much blood and

<sup>1</sup> See PROGRESSIVE MEDICINE, March, 1899, p. 234, for review of pathology of Wright's observation.

shock is marked the surgeon has to decide between two dangers—that of death due to an immediate operation or infection from delay. My experience in the clinic of Professor Halsted (and as far as I am able to judge from the majority of others) teaches as follows :

Recently injured limbs demanding amputation can be divided into two groups : Those patients whose general condition is good, the symptoms of shock slight, and in whom the loss of blood has been but very little. In such cases an amputation may be done at once. Nevertheless, there is no great hurry, and it is always better to give the patient the benefit of the doubt. The patient should be placed in bed and external heat applied ; salt solution per rectum and under the skin, although not positively indicated, will be a safeguard. A hypodermatic of morphine (gr.  $\frac{1}{10}$  to  $\frac{1}{8}$ ) will do good by its relief of pain and restlessness. The injured part can be prepared carefully for operation. This delay of from one to two or three hours decreases rather than increases the possibilities of death. The operation can be done carefully and completely, and unless the surgeon misjudges the condition of the patient, the mortality should be practically *nil*.

All other cases belong to the second group. In these one observes all degrees of shock from varying amount of loss of blood and shock due directly to the extent and nature of the injury.

In such cases one should check the slightest loss of blood, and at once treat the patient most energetically for shock and loss of blood, if any has occurred. Quiet in a bed elevated at the foot, external heat, repeated and *slow* infusion of salt solution beneath the breasts, and, if retained, salt per rectum, hypodermatic injection of small doses of morphine (gr.  $\frac{1}{20}$  to  $\frac{1}{10}$ ), unquestionably do good. The advantages of hypodermatic injection of strychnine and atropine are difficult to estimate. Hare is very positive that atropine is indicated, because of its action on the vasomotor apparatus. It seems settled, from a pathological stand-point, that it is not the heart but the vasomotor system that is collapsed in shock. The heart needs more fluid, which can be supplied by salt infusion, but the vasomotor constriction needs assistance ; its weakness with dilatation of the vessels means death ; theoretically, and apparently practically, atropine is the drug. External heat, with elevation of the foot of the bed, and salt infusion are the chief remedies.

The amputation must not be delayed too long—after, perhaps, six hours each hour increases the danger of infection—but just how long the surgeon should delay is a difficult and, I believe, not yet settled question.

In the majority of cases, if the patient is to recover at all from the shock, some signs of improvement should be seen in four to six hours. In these cases the operation should be rapid and the anæsthetic time very



short. The operation should consist of a simple amputation of the crushed member.

To do this, except at the shoulder or hip-joint, should take but a few minutes. A very little ether is given. The Esmarch bandage is rapidly applied, and severing of the soft parts and bone takes but a moment. The anæsthetic is discontinued. The clamping and tying of vessels can be done without it and the wound should be left open. In a few cases, after twenty-four or forty-eight hours, the patient's condition will allow a secondary suture. In the majority of cases one must wait longer for the secondary operation. The importance of recognizing the condition of the recently injured patient cannot be overestimated. Properly delayed, the later very rapid amputation will seldom of itself be a factor in the death, should it take place.

THE DECISION OF THE PROPER MOMENT TO AMPUTATE FOR AN INFECTION IS A SECOND VERY DIFFICULT QUESTION. The happy results of an early amputation in the gas bacillus infection have been demonstrated in this article. No careful observation of a great number of cases has appeared in the literature either of amputation in relation to shock or to infection.

The decision is much more difficult in infection. In the recently injured, the condition of the limb as a rule indicates of itself that an amputation must be done. In infection it is the danger of death from toxic or bacterial general infection which demands the removal of the limb. The proper moment to amputate to avoid the danger is always a difficult one to decide. When the local infection has made the limb useless amputation is indicated irrespective of the general condition of the patient.

I have discussed these two indications for amputation chiefly to show that mortality statistics, if properly made in a sufficient number of cases, would be of great value, especially to surgeons whose personal experience is still limited. Experience in such cases is only gained in unusually large clinics and after a number of years. Even in these clinics there is still room for improvement in the mortality rate of amputations for recent wounds, compound fracture, and for infection.

**Amputation for Pathological Conditions.** In this operation we practically need not consider the mortality; the question is whether the diseased condition itself indicates an operation. New growths, tuberculosis, and osteomyelitis are the most usual indications.

Until recently a diagnosis of SARCOMA of the limb indicated an amputation, but later observations have demonstrated that a resection will give in many instances as frequent immunity to local recurrence as amputation.

Amputation is seldom performed for TUBERCULOSIS. The early recognition of the disease with proper treatment in some cases leads to a cure

without even an excision of the joint, and experience has taught us that an excision, even if all the local disease is not eradicated, leads to a perfect result.

**OSTEOMYELITIS** is seldom an indication for amputation. In cases where the entire diaphysis is a sequestrum, proper treatment will allow the periosteum to replace this defect. The early recognition and proper treatment of a secondary infected joint is frequently followed not only by a recovery but by a movable joint.

**Osteoplastic Amputation.** The most important recent contributions to amputation are those which deal with the osteoplastic method, especially Bier's. These operations are confined to the lower limb, chiefly the leg. Their object is to make a stump which will bear direct pressure without discomfort, so that the end of the stump will carry the weight of the body. Hildebrandt<sup>1</sup> has written the best and most complete article on the subject. In English and French literature one sees little mention of this important addition, and even in Germany it seems to have received little attention except adverse criticism. Hildebrandt's observations, I am sure, will produce the proper reaction in its favor. Hildebrandt writes from Prof. von Esmarch's clinic, where Bier introduced his method in 1892 and 1893. This very thorough article first considers the causes of atrophy of both the soft parts and the bone of the stump. This atrophy always takes place in stumps which do not directly bear the weight of the body. The causes of this atrophy are carefully considered—the decreased use, the loss of function from the division of muscular insertions, the absence of direct pressure on the bone in the stump. The artificial limb in these cases carries the weight of the body indirectly by circular compression of the limb, and this increases the atrophy.

Hildebrandt's observation of such stumps of various ages corresponds with those of others as to this well-known atrophy, and needs no further discussion. The relatively less atrophy, and frequently the entire absence of atrophy in stumps (chiefly the bone) which carry directly the weight of the body, have been observed by Hildebrandt in all his cases. This observation has escaped others because this form of stump is not a common one, and especially as those of Bier's method are of recent date. The most important contribution of the article is in regard to the factor which allows certain stumps to bear direct pressure. The following stumps have this important function :

1. *Pirogoff's amputation*, in which the sawn os calcis is placed against the sawn surface of the tibia and fibula. (See Fig. 10.)
2. *Ssabanejew*. In which a longitudinal section from the tibia is

<sup>1</sup> Deutsche Zeitschrift für Chirurgie, March, 1899, Band li., Heft 1 and 2.

placed over the sawn surface of the condyles of the femur. (The resultant stump is better than after a Griette.)

3. *All Exarticulations.* In these cases there is no exposed bone to produce callus or a bone-scar.

4. *Kummer and Ollier.* A method in which the sawn surfaces of the tibia and fibula are covered with a flap from the sole of the foot. In this case the bone-scar is covered with a thick layer of skin, which is used to pressure.

FIG. 10.



X-ray photograph of Pirogoff amputation; no bone atrophy.

5. *Bier's osteoplastic amputation of the leg,* in which the sawn surfaces of the tibia and fibula are covered with a bone-plate from the tibia. The bone-scar in this case is at the side and not on the end of the bone. Hildebrandt agrees with Bier, that it is the callus which produces a tender bone-scar and prevents any direct pressure in all diaphyseal stumps. The bone is always (even a metacarpal bone) strong enough to bear the weight; it is always the pain and tenderness to pressure which prevents the stump from bearing the weight of the body.

It is, therefore, the exposed bone-scar with its tender callus which does not allow the stump to carry the weight of the body. This tenderness of all diaphyseal amputation stumps is well recognized by surgeons. It varies with different cases, but seldom is such a stump able to carry the body on its end.

Amputations through the epiphysis, according to many observations, are less likely to be tender than those through the shaft. Some of these stumps, as Syme's at the ankle and Carden's at the knee, will now and then be able to carry direct. Hildebrandt believes it is due to the less callus thrown out by the exposed bone-surface in the epiphyseal stump, and chiefly because the bone-area is larger and the weight distributed.

FIG. 11.



X-ray of stump—Bier's method of osteoplastic amputation.

Practical observations demonstrate that the epiphyseal stump stands direct pressure frequently, but by no means always. The end of a stump by exarticulation has no bone-scar; it is never tender, and can always carry the weight directly.

Gritti's amputation at the knee is theoretically correct: the bone-scar is not exposed, but for some reason such stumps in at least 50 per cent. of cases do not stand direct pressure. The character of the skin and the bursæ on the patella, according to Hildebrandt, may explain this.

In Bier's amputation, if the bone-plate is too small, or when it has slipped, the exposed bone-scar becomes tender as in other amputations, and this misfortune may detract from the result. Hildebrandt's obser-

vation of a number of amputations after Bier's method demonstrated conclusively an absence of atrophy in the stump (chiefly the bone), painless scar, and the ability of the stump to bear (directly) the weight of the body. Practically the leg stump of the Bier method is the most useful one. Although Bier did not think that his method was especially applicable to the shaft of the femur, Hildebrandt goes further and advocates the osteoplastic method here, believing that a stump which could bear some or all the weight would be more useful than the usual one in which the pelvis carries the weight. These observations should influence all surgeons to cover the exposed sawn surface of the diaphysis, and even if possible the epiphysis, with a bone-plate, so that the bone-scar is at the

FIG. 12.



X-ray of stump—Bier's method of osteoplastic amputation.

side and not at the end of the stump. Although we have not followed Bier's method as yet in the surgical clinic of the Johns Hopkins Hospital, Hildebrandt's article has convinced me that this osteoplastic method will give more useful stumps.

Figs. 11 and 12<sup>1</sup> are excellent X-ray photographs of two amputated stumps; neither shows atrophy. In Fig. 12 the union of the bone-plate is fibrous; this condition, however, did not impair the result.

BRUNS' SUBPERIOSTEAL AMPUTATION OF THE LEG. Otto Hahn<sup>2</sup> writes on this method from Professor Bruns' clinic, and reports on eighty-

<sup>1</sup> Deutsche Zeitschrift für Chirurgie, 1899; Band li., Heft 1 and 2, pp. 134, 135.

<sup>2</sup> Beiträge zur klinischen Chirurgie, Band xxii.

one cases which have been observed since the method was introduced in 1893. The principle of this method is to make two flaps which consist of all the soft parts, including the periosteum ; in some cases a separate skin-flap is made.

The advantages are : (1) It is technically easy ; (2) it gives the best condition for wound healing ; (3) the danger of gangrene of the flaps is greatly diminished ; (4) it makes a good and satisfactory stump ; (5) it is satisfactory for all conditions.

Hahn criticises Bier's osteoplastic amputation, because it is technically more difficult and because the immediate healing is not so good or certain as in the Bruns method, and because the form of the stump after the latter method is more perfect. I agree with Hildebrandt's answer to this criticism, that the ultimate form of the stump, and especially its ability to bear directly the weight of the body, are the most important considerations. Hahn does not discuss this point, and Hildebrandt has clearly proven the ultimate advantages of the osteoplastic stump. The question of a periosteal flap is not yet settled. The great majority of surgeons do not think it is necessary except when an osteoplastic operation is done. Bier uses a periosteal flap, with and without the soft parts, to nourish the bone-plate.

Given a patient in good condition for operation an amputation is a very simple affair. One should make long flaps of skin and if possible of muscle (all the soft parts). The immediate advantage of thick flaps (as in Bruns' method) is the better circulation. Later, atrophy may take place. A cushion of soft parts, except thick skin like the sole of the foot, is of no value to help the bone carry the direct weight of the body. We seldom see suppuration except after amputation for infection. The cause in such cases is not the method of amputation. Gangrene of the flaps is uncommon except after amputations for severe injuries, when the surgeon in his zeal to save as much as possible of the limb retains skin whose circulation is injured by contusion. From a careful and somewhat extended reading of recent literature on amputation compared with our experience in Professor Halsted's clinic, I am inclined to feel that a special method of amputation is of little importance. It is simply necessary to make flaps whose circulation is good and which when sutured will be under no tension. One avoids distention of the wound with blood by very careful ligation of the vessels. These flaps will vary with the condition of the parts amputated. The nearer to the circular method the better. However, to obtain with certainty a stump which will bear direct pressure, one must cover the diaphyseal, and if possible even the epiphyseal surface with a bone-plate after the method of Pirogoff, Ssabanejew, or Bier. If this cannot be done at the first operation it can always be accomplished later, as shown by Bier and Hildebrandt

FIG. 13.

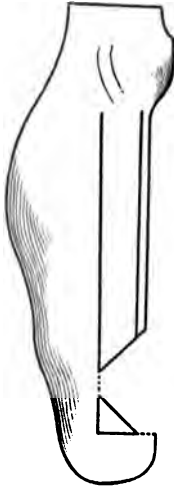


FIG. 14.



Bier's method of secondary osteoplastic amputation.

FIG. 15.



X-ray of stump, showing ends of bone covered after the secondary osteoplastic method shown in Figs. 13 and 14.

(Figs. 13 and 14<sup>1</sup>), by removing a wedge of bone from the shaft at some distance from the end of the stump and then turning up the bone and

<sup>1</sup> Deutsche Zeitschrift für Chirurgie, Band li. p. 139.

the soft parts. This procedure removes the bone-scar from the pressure end (Fig. 15).

Solomoisci<sup>1</sup> gives a complete history of all forms of osteoplastic amputation.

**Amputation of the Hip-joint.** Levison,<sup>2</sup> of San Francisco, reports two successful cases after Wyeth's method. Wyeth,<sup>3</sup> in 1897, collected 68 operations after his own method, with a mortality of 15.9 per cent. Levison collected 16 additional cases, which, added to Wyeth's list, give a mortality of 15.28 per cent. Whether the introduction of the Wyeth method has reduced the mortality in hip-joint amputations is a very difficult question to settle. McBurney<sup>4</sup> recommends the direct compression of the common iliac artery through an abdominal incision.

It is Professor Halsted's practice both in hip and shoulder amputations to cut directly down on the great vessels and secure them with ligatures. The usual skin incision for these amputations is in line with the vessels. After their ligature the amputation is proceeded with, the smaller vessels being tied as they are exposed. Muscles are divided as closely to their tendon as possible. This dissection method presents no difficulties, and so far, in four hip-joint and five shoulder-joint amputations, no mortality. The indications were all pathological conditions (sarcoma of bone). In the recently injured and in infection cases, so far, we have always been able to meet the indications by a high thigh or arm amputation. In very critical cases the Esmarch bandage has been placed high and the limb rapidly removed. In our few cases there have been no deaths. In amputation at the hip and shoulder, in which the patient is not suffering from shock or infection, I believe the dissection method will be found as satisfactory as any.

Whether the method of securing the vessels by Wyeth's pins will allow a much more rapid amputation, with much less loss of blood in cases in which time is the most important factor, I am not prepared to say, nor do I feel that statistical tables so far published prove this.

One should hesitate to amputate at the hip-joint or shoulder-joint on patients critically ill from shock or infection, and select if possible the high thigh or arm amputation, which can be performed with great rapidity and with no loss of blood.

**Exarticulation of the Whole Upper Extremity.** This is indicated only in malignant growths, and one is surprised to find how simply and bloodlessly the operation can be done. The clavicle is resected and the subclavian vessels secured, after which the operation is a very simple dissection, even if the surgeon is compelled to divide the muscle at some

<sup>1</sup> *Revue de Chirurgie*, 1899, iii. p. 365.

<sup>2</sup> *Journal of American Medical Association*, July 24, 1899.

<sup>3</sup> *Annals of Surgery*, vol. xxv.

<sup>4</sup> *Ibid.*, 1898, vol. xxviii.



distance from the scapula, on account of the infiltration of the neoplasm. A number of such operations are reported from time to time in the literature, but no addition to the technique has been made, nor does there seem to be any needed.

### TRAUMATIC GANGRENE.

**Traumatic Gangrene from Rupture of the Inner Arterial Coats.** Hertzog,<sup>1</sup> from the clinic of Professor Bruns, in Tübingen, has given us an excellent report of a case and a résumé of the literature on this subject. It is of the utmost importance for surgeons to remember that from a simple contusion over an artery, without injury of the skin, with or without fracture, the internal coat of the artery may be ruptured, and this may be followed by thrombosis and gangrene. It is important also from a medico-legal stand-point, especially in cases of fracture and in those cases where the injury has apparently been a simple one yet gangrene has taken place, and the surgeon himself may for a moment believe that it has been due in some way to his treatment.

Hertzog states that traumatic gangrene as a result of the rupture of the internal coats of the artery is given but a meagre notice in the majority of standard works on surgery, although other injuries to the arteries are discussed at length, both in text-books and in the literature. He reports one case, and has been able to collect from the literature sixty-two others, in which following a contusion of the artery there has been an isolated rupture of the intima alone, or the intima and media, which has been followed by thrombosis and in the majority of cases by gangrene.

In the case reported by Hertzog the patient, a strong, healthy man, thirty-two years of age, received a severe contusion on the popliteal space, and in addition the leg was caught between two opposing forces and wrenched. There was no rupture of the skin and no fracture. Immediately following the injury there was a good deal of swelling and pain of the knee and later of the leg (but no hæmatoma). On the third day the foot was cold and there was distinct loss of sensation. The patient was admitted to the surgical clinic on the sixth day. There was slight fever and evidence of gangrene of the leg, with the line of demarcation about the middle third. No pulsation was to be felt in the popliteal artery or in the vessels below. Fever continued, and on the twelfth day the leg was amputated at the knee, after Gritti's method.

On examination it was found that there was a circular rupture of the inner two coats of the popliteal artery at about the level of the knee-

<sup>1</sup> Beiträge zur klinische Chirurgie, 1899, Band xxiii., Heft 3, p. 643.

joint. These two coats had rolled upon themselves, and the vessel was thrombosed above the seat of injury. In this case the wound after the operation healed per primam and the patient recovered. We are familiar with a number of injuries to arteries. There may be a complete or partial rupture of the three coats of the artery, allowing extravasation of blood and the formation of a false traumatic aneurism or hæmatoma. Or following the contusion the weakened walls may give way to the formation of a traumatic aneurism. These are the more frequent results of injury. The less common occurrence is a rupture of the intima or the intima and media, following which the two coats of the artery roll upon themselves, with the formation of a thrombosis always above, and sometimes below, the seat of rupture. In Hertzog's 63 cases the arteries have been involved in the following manner: Brachial, 18 cases; popliteal, 15 cases; axillary, 7 cases; femoral, 8 cases; external iliac, 4 cases; common iliac, abdominal aorta, and posterior tibial and subclavian, each 2 cases; the internal carotid, radius and ulnar, each 1 case.

Although arterio-sclerosis predisposes the artery to rupture after injury, this form of rupture may take place in apparently healthy people with unchanged arteries. The cause is always a direct trauma. In recent fracture and dislocation it is sometimes difficult to tell whether rupture was due to the primary injury or to the force used in the reduction. This should be constantly borne in mind. In every recent dislocation or fracture one should ascertain the pulsation of the peripheral arteries at the first examination and immediately after reduction. As a rule, if one uses care and force in the proper direction, rupture of the artery should not follow surgical intervention.

Of the 63 cases reported, 7 died from shock, or other extensive injuries, before sufficient time had passed to allow the manifestations of gangrene. At the autopsies in these cases the circumscribed rupture of the inner coats of the artery was demonstrated. Of the remaining 56 cases, in 23 there was no gangrene and in 38 cases gangrene resulted. Evidence of rupture in 35 cases was ascertained at autopsy or at operation, in which the artery at the site of injury was excised. In 21 cases the diagnosis was made from the clinical course. Of 30 cases investigated anatomically, in 9 the intima alone was torn and in 21 the intima and media together. With two exceptions the tear was transverse; in one case there was a cross tear; in a second case there were two tears at acute angles with each other; a longitudinal tear was not observed. In the majority of cases the tear was complete; in a few cases it was incomplete. The coats were rolled up and the thrombosis was situated above the point of rupture. In many of the cases the blood-stream is not completely checked at once. There is a slowing of the blood-stream by the thrombus, and finally a complete obstruction. Of the 63 cases, in 37 the rupture was associated

with fracture and in 4 with dislocation. In the great majority of cases there was no injury of the skin, but in many cases there was contusion or laceration of the muscles and subcutaneous tissue, indicating the severity of the direct force.

Clinically, we must make a differential diagnosis between this form of rupture and that in which there is complete or partial rupture of all the coats, with the formation of a false aneurism or hæmatoma. In both we have cessation of pulsation in the peripheral vessels, while in the one in which an aneurism or hæmatoma forms there is in addition a large tumor at the seat of rupture. When after the injury to one of the extremities we demonstrate cessation of pulsation, loss of sensation, and lowering of the temperature of the part, it is a distinct indication of rupture of the artery. If there is no marked tumor along the line of the vessels the probable diagnosis is a circumscribed rupture of the inner coats.

It is remarkable in how many cases the collateral circulation has been established and gangrene has been averted ; consequently, in the treatment of this condition, everything should be done to aid collateral circulation : the elevation of the part, massage, and gentle, firm bandaging. Hertzog states that a hæmatoma or swelling of the part, in addition to the injuring of the artery, increases the probabilities of gangrene. He does not suggest any operative treatment for such a condition. It would seem a good surgical principle, however, the moment there is evidence of loss of pulsation in the peripheral vessels of the limb and the presence of a hæmatoma or some swelling at the probable seat of the injured artery, to make an incision over this tumor, in order to relieve the tension of the part, as an aid in the formation of collateral circulation.

Recently, Mitchell has observed a case in Professor Halsted's clinic in which gangrene of the foot and leg followed rapidly after a simple comminuted fracture of the lower third of both bones of the leg. It was difficult to get a positive history in this case. The patient had fallen a number of feet and had apparently landed on the foot of the fractured leg. Whether there had been direct injury by some external force on the leg at the seat of fracture, or whether the arteries had been directly contused by the comminuted bone, it is difficult to say. There was very little deformity when the patient was admitted to the hospital and no swelling. The leg was put up in plaster. A few hours later the patient complained of pain, as if the dressing was tight. The plaster was at once cut down over the foot and ankle, but it was demonstrated that the bandage was not producing constriction. At this time it was noted that the foot was not cold. Thirty-six hours later the patient had fever (103° F.), the foot became cold, sensation was not as good, and no pulsation could be made out in the anterior or posterior tibial arteries.

Fever continued with some pain ; there was, however, no swelling of the foot and leg, which simply continued cold, and the area of anæsthesia extended up into the lower third of the leg. The patient was a colored man, and it was difficult to make out the direct line of demarcation. On the fourth day the leg was amputated. It appeared as if the line of demarcation of the skin was about the lower third of the leg, corresponding to the position of the fracture. On cutting into the muscle, however, the evidence of gangrene extended further up. The leg was again amputated, at the upper third. It was found that the tibial arteries were thrombosed down to the seat of fracture. Below this the arteries were free ; the thrombosis of these two arteries extended beyond the point at which amputation took place. There was pulsation, however, in the popliteal artery. Unfortunately, no direct examination was made of the condition of the coats of the arteries at the point of beginning of thrombosis. There was, however, no rupture of the entire arterial wall, and there was no extravasation of blood.

Clinically and anatomically, except for the direct demonstration of the rupture of the inner coats, this case corresponds to those reported by Hertzog of gangrene following circumscribed rupture of the inner coats of the arteries.

Although there was no evidence of infection in Mitchell's case there was fever. This was noticed in many of Hertzog's cases. Hertzog found that when gangrene appeared the manifestations began within from a few hours to the ninth day ; in the majority of cases within a few days.

I do not think it is out of place for me to impress upon my readers the importance of more careful observations on recent injuries. The great majority of these cases are first observed by the younger surgeons in the hospitals. And they should always be on the alert for the interesting and rare conditions. In every injury of the extremities one should at once palpate for pulsation in the peripheral vessels and note any evidence of nerve-injury. For a number of days, and during the first few days at quite frequent intervals, especially in cases where there is any pain or anæsthesia in the foot, the surgeon should carefully examine for any evidence of injury to the artery.

#### **Traumatic Gangrene from Rupture of all the Arterial Coats.**

Recent articles by Schultz, Böttcher, and Meyer discuss this form of injury. These publications with Hertzog's give a complete review of the subject. Böttcher<sup>1</sup> and Schultz<sup>2</sup> together have collected thirty-four cases of rupture of the popliteal artery. Böttcher's excellent publica-

<sup>1</sup> Deutsche Zeitschrift für Chirurgie, 1898, Band xlix., Heft 2 and 3.

<sup>2</sup> Ibid., 1897, Band xlvi.

tion is entitled *On the Mechanism of Subcutaneous Rupture of Arteries in Connection with a Case of Tearing of the Popliteal Artery*. His case was observed in Professor von Bruns' clinic. The patient was forty-nine years of age, and the trauma was a sudden overextension of the right limb at the knee. Sudden, intense pain was experienced at the knee, and locomotion was impossible. When examined by his physician one hour later a large swelling was present in the popliteal space, and the patient was in a condition of shock. Not until the third day were coldness and anæsthesia of the foot noted (they may have been present before). On the sixth day the patient was admitted to the clinic, and gangrene was evident. At the operation a large hæmatoma was found in the popliteal space, and an oblique tear in the artery just as it passed through the adductor slit. Thrombosis of the vein was present, beginning at some distance below the level of the arterial rupture. Recovery followed a Gritti amputation. Bötticher expresses the opinion that an early operation within the first few hours might prevent gangrene of the leg.

Meyers<sup>1</sup> reports his case of rupture of the popliteal artery, because the most prominent sign (hæmatoma in the popliteal space) was not present. Billroth<sup>2</sup> has reported a similar observation.

The characteristic symptoms of these injuries are sudden, intense pain, a rapidly forming tumor beneath and about the knee, and the feeling of great tension in the popliteal space, followed in a few hours by increasing coldness and anæsthesia of the foot and leg, and a few days later by definite signs of gangrene. In Meyers' and Billroth's cases all the signs except the swelling and the sensation of great tension were present. In these two cases, for some reason, the ends of the ruptured arteries became so rapidly plugged with a thrombus that any extensive extravasation of blood was prevented. Meyers dwells upon the fact that in the great majority of these cases, even when swelling was present, the correct diagnosis was not made until gangrene was evident.

The importance of an early diagnosis rests upon the fact that after gangrene has become evident amputation must be done. Recognized in the first few hours, an incision relieving the tension from the extravasated blood, with ligation of the ruptured vessels, might so aid the collateral circulation that the leg could be saved. The increasing coldness and anæsthesia of the foot and leg and the absence of pulsation in the tibial arteries are constant and early signs, and even without a hæmatoma they should be sufficient indication for an early operation.

<sup>1</sup> Deutsche Zeitschrift für Chirurgie, April, 1899, Band li., Heft 3 and 4.

<sup>2</sup> Archiv für klinische Chirurgie, 1899, Band x.

## SURGERY OF JOINTS.

**Tuberculosis of Bones and Joints.** I shall reserve for the next publication of PROGRESSIVE MEDICINE a more extended discussion of this subject, because as yet I have been unable to obtain Professor Krause's most recent work.<sup>1</sup> Helferich,<sup>2</sup> in his short review, says that this is a most complete work, and that it is full of many new and excellent additions to our knowledge of this very important subject.

Nichols<sup>3</sup> writes from the Sears Pathological Laboratory of the Harvard Medical School. His observations during three years are based on over one hundred and twenty tubercular joints, including specimens of nearly every bone and joint in the body. The specimens were obtained from excisions of joints and from amputations and autopsies. The following summary is given at the end of this excellent contribution :

1. Many observations prove that tubercular disease of the bones and joints is produced by the tubercle bacillus.

2. Congenital tubercular disease of the bones and joints is not proved.

3. Injuries of moderate severity favor the production of the disease.

4. In the long bones the disease, as a rule, begins in the epiphysis.

5. *Tubercular disease of the joints is generally, if not always, secondary to disease in the epiphysis in adjacent bone.*

6. "Cold abscess" is due to the extension of the tubercular disease to the soft parts. The wall of the abscess and its contents are unlike those of infectious abscesses.

7. Repair is brought about by the formation of fibrous tissue, which replaces or partly encapsulates the tubercular tissue. Repair may be incomplete. Fibrous bands may cause fibrous ankylosis of joints, or the fibrous tissue may be ossified and result in bony ankylosis.

8. Paraplegia in Pott's disease rarely is due to bony pressure. Usually the pressure is caused by tubercular external pachymeningitis, or, perhaps, by œdema. Sometimes pressure or œdema leads to degeneration of the cord.

9. Hip-disease frequently begins in the acetabulum.

10. Tumor albus may begin in any bone of the knee-joint. Muscular action produces flexion and backward subluxation of the leg. Extension of the leg without correction of subluxation may occlude the popliteal artery.

11. Caries of the ankle may affect many bones and joints early.

12. Inoculation of susceptible animals is the surest way of determining the character of doubtful joint or bone-lesions.

<sup>1</sup> Deutsche Chirurgie, 1899, Part 28a, published by Ferdinand Enke, of Stuttgart.

<sup>2</sup> Deutsche Zeitschrift für Chirurgie, April, 1899, Band li., Heft 2 and 3.

<sup>3</sup> Transactions of American Orthopedic Association, 1898, vol. xi.

THE RELATION BETWEEN TUBERCULOSIS OF BONES AND JOINTS AND ACUTE MILIARY TUBERCULOSIS. Benda<sup>1</sup> is of the opinion that during operations on tubercular bones and joints the tubercle bacilli which enter the circulation are not always destroyed, but that some become attached to the intima of the larger veins and produce a metastatic tuberculous nodule. In the further growths at this spot numerous bacilli may enter the circulation at the same time, producing a marked bacterial toxæmia, which is followed by acute miliary tuberculosis. Benda's views are based on three cases (two of tuberculosis of the hip, both operated on, and one case of tuberculosis of the vertebra).

The possibility of disseminating the tubercle bacilli during operation should always be borne in mind. Theoretically, it might appear that the use of the Esmarch bandage during operation, and the careful cutting, if possible, through healthy tissue, rather than curetting, would lessen this danger. Practically, surgeons seldom observe acute miliary tuberculosis following operations; however, if the patients were more carefully observed for some months and even years afterward we might find that this dissemination is not so rare.

TUBERCULOSIS OF THE SHAFT OF LONG, HOLLOW BONES: Küttner<sup>2</sup> remarks: "Just as often as tubercular osteomyelitis affects the marrow of short, hollow bones, just so seldom does it affect the marrow in the shaft of the long, hollow bones." Among 2127 cases of tuberculosis of bones and joints observed in the clinic of Professor von Bruns, in Tübingen, there have been six cases of tubercular osteomyelitis of the marrow in the shaft of long, hollow bones (0.28 per cent.). He does not consider the cases of acute miliary tuberculosis which are not infrequently associated with metastatic areas in the spongiosa of the diaphysis. He considers only those cases in which the disease was primarily in the marrow of the diaphysis or secondary to tuberculosis of the joint or the spongiosa of the epiphysis.

Nichols<sup>3</sup> says: "I have never seen this form of disease," although he carefully studied over one hundred and twenty specimens. Nichols refers, with references, to the works of Volkmann, Krause, König, and Ziegler, who described this condition. Krause claims to have seen primary tubercular disease of the diaphysis of the long, hollow bones. He says it always comes in children under four years of age who have tubercular disease elsewhere. Kahn reported ten cases (two of Krause's); none came to autopsy, and all of the patients had signs of tubercular disease elsewhere. It is interesting to note that many of these cases were considered clinically to be acute infectious osteomyelitis. Nichols

<sup>1</sup> *Centralblatt für Chirurgie*, 1899, No. 27.

<sup>2</sup> *Ibid.*

<sup>3</sup> *Transactions of American Orthopedic Association*, 1898, vol. xi.

is of the opinion that these cases may have been secondary to tubercular areas in the epiphysis similar to those described by Volkmann, in which the disease arises in the epiphysis and extends over nearly the whole shaft. The process may affect both bones of a joint. The whole marrow may be converted into a dry, yellow caseous mass, with here and there a little pus, or, rarely, a tubercle.

Küttner believes he has observed one case in which the disease was primary in the shaft; the patient was twelve years old; a thickening of

FIG. 16.



FIG. 17.



Tuberculosis of the shaft of femur and humerus secondary to disease of the epiphysis.

the upper tibia, which was slightly elongated, and a fistula, which had followed suppuration, were noticed. There had been some discharge of sequestra. The clinical appearance and X-ray photograph gave no suspicion of tuberculosis; at the operation, however, tuberculosis was suspected, on account of the worm-eaten appearance of the sequestrum and the characteristic (?) appearance of the granulation tissue. The disease was confined to the marrow cavity; the spongiosa of the epiphysis and diaphysis were free. Küttner's five other cases were secondary to





PLATE III.



X-ray of Küttner's case of primary tuberculosis of the shaft of the tibia.

tuberculosis of the joint and epiphysis. The disease in each case was very extensive, and it was necessary to amputate.

Plate III.<sup>1</sup> is an excellent X-ray photograph of Küttner's primary tuberculosis of the shaft of the tibia. The disease was eradicated by chiselling, and when the patient was discharged the wound was completely healed. Figs. 16 and 17<sup>2</sup> are sections from the femur and humerus respectively, showing tuberculosis of the marrow of the shaft secondary to disease of the epiphysis.

In operations on tubercular joints one should always bear in mind the secondary involvement of the marrow of the shaft; and in operations for chronic osteomyelitis of the diaphysis, one should observe carefully the gross clinical appearance of tuberculosis, and should especially study the tissues microscopically.

**TUBERCULOSIS OF THE SYMPHYSIS PUBIS.** Von Büniger,<sup>3</sup> of Hanau, considers one of his own and a few cases found in the literature of this very rare and almost unknown site for tuberculosis. This article should be read in connection with that of Kirschner concerning acute osteomyelitis of the pubic bones at the symphysis.

Clinically, in the early stage the disease is very difficult to recognize. The patient complains of dull pain radiating to the groin, which is usually considered to be neuralgic; however, if one examines such a patient carefully slight local tenderness to pressure and concussion can be demonstrated about the symphysis pubis; this palpation should be made directly and also by rectum and vagina. In the second stage a tumor is evident; this tumor occupies the space of Retzius, posterior to the recti muscles. As a rule the tumor cannot be demonstrated in the middle line, on account of the thickness and tension of the muscles; but in the groin, to the outer side of each rectus, a reducible swelling is found. These tumors are frequently mistaken for hernia. They appear when the patient stands or coughs, and disappear when the patient lies down. The skin and subcutaneous tissue are not infiltrated and the swellings are not tender. Now and then such abscesses have been cut down upon for hernia; the mistake, of course, is not a serious one. Careful examination, however, should exclude the possibility of a rupture. In the third stage the presence of the fistula, the demonstration by the probe of the dead bone, associated with the history of the case, as a rule are sufficient for a positive diagnosis. These fistulæ seldom form in the middle line, but usually at some point in the groin near the scrotum or labia, or below Poupart's ligament; very rarely does the tumor present itself in the perineum or the fistula form in this region.

<sup>1</sup> Beiträge zur klinische Chirurgie, 1899, Band xxiv., Heft 2.

<sup>2</sup> Küttner, p. 464.

<sup>3</sup> Centralblatt für Chirurgie, 1899, No. 27.

Even in the late stages one is seldom able to get abnormal mobility at the symphysis pubis. The treatment should always consist of a thorough removal of the disease with the knife and chisel; the earlier this is performed the better, and one is surprised at the excellent functional result after the removal of even a large amount of bone. The periosteum, if possible, should be preserved; if this is possible the cavity will be almost completely replaced by new bone.

**OPERATIVE TREATMENT OF TUBERCULAR JOINTS.** Maylard,<sup>1</sup> of Glasgow, considers this subject in an article entitled "*Erasion versus Excision in Childhood.*" His observations, however, are based on only twenty-six operations dating back to 1887. His conclusions are: that the shortening of the limb after erasion is little, if any; while after an excision of the joint, shortening, even considerable, is seldom absent. I do not think that Mr. Maylard has clearly proved his point. Of course, if in his operations for excision of the joint the epiphysis were injured or removed, shortening would always follow; but when the epiphysis is preserved (which should always be done), the shortening would depend upon the destruction of the epiphysis by the tuberculous process, which would be the same, no matter what the operation. In connection with the changes in the growth of the shaft in cases of tuberculosis of the joint, we should bear in mind that in some cases lengthening rather than shortening takes place. Pels-Leusden,<sup>2</sup> in an article entitled "*On the Changes in the Growth of the Femur to be Observed in Tuberculosis in the Knee-joint,*" considers this very extensively, and gives twenty-three references to the literature. Leusden considers in detail thirty-four cases of knee tuberculosis observed in Professor Braun's clinic in Göttingen, and draws the following conclusions: (1) The X-ray photograph is the best means to demonstrate the changes in form in the bone in relation to the soft parts, in comparison with the opposite limb; (2) in chronic tuberculosis of the knee, in the period of growth, shortening of the femur is rarely observed, while lengthening is frequent, and this lengthening continues as long as the disease is active; (3) the lengthening is always in the shaft, and is mainly caused by an increase in growth from the lower epiphysis, due to irritation of the disease situated in the joint or in the epiphysis.

**The Treatment of Arthritis with Superheated Air.** The introduction of this method has without doubt been a valuable addition to the therapeutics of different forms of arthritis. Although numerous articles have appeared in the literature, one is not yet able, either from a single article or from a compilation of all, to form a definite opinion of

<sup>1</sup> Edinburgh Medical Journal, June, 1899.

<sup>2</sup> Deutsche Zeitschrift für Chirurgie, April, 1899, Band li., Heft 3 and 4.

the exact therapeutic limitations of this treatment, except that unquestionably it has its limitations. Every surgeon should be very careful not to allow this treatment to be continued too long before resorting to operative procedures ; especially is this true in the acute forms of arthritis. Krause<sup>1</sup> discussed before the last German Surgical Congress his experience with superheated air in 100 cases during a period of one year and a half. In the following conditions this treatment has been followed : Joint diseases from arthritis rheumatica, gonorrhœica, deformans, sicca, crepitans, urica ; acute chronic muscular rheumatism, lumbago, sciatica, chronic osteitis and periostitis, achillodynia, and, finally, stiffness of the joints and pains in limbs after injuries ; contusions of the bones and joints, as well as of the soft parts, sprains, luxations, and fractures, as well as the painful tension of the muscles of the fixed flat-foot.

Krause observed satisfactory results in about two-thirds of these cases ; in the remaining cases there was absolutely no improvement. In the cases in which improvement was observed the swelling decreased, the pain disappeared, and the motion of the joint became freer. As Krause states, although an improvement was noted in cases in which there were serious pathological changes, the real influence on the pathological condition could not be ascertained with any degree of certainty. It is to be noted that Krause did not use this treatment in any form of acute arthritis except, perhaps, gonorrhœal.

Loewenhardt,<sup>2</sup> of Breslau, discussed before the last German Surgical Congress the treatment of gonorrhœal arthritis by this method. He has used superheated air since 1895, and has found that the pain is greatly decreased and that the effusion into the joint is diminished. Even in cases in which the para-arthritic infiltration and œdema were of high grade and the general toxic symptoms severe, the treatment with superheated air did good, and no bad results were observed.

In Professor Halsted's clinic arthrotomy and irrigation have given such uniformly excellent results that personally I should first resort to this operative method, which, if necessary, could be followed by the treatment with hot air. It is my rule in gonorrhœal arthritis to aspirate the joint. When the effusion is purulent, and when the gonococcus is found in cover-slip and culture, I at once open the joint and irrigate it with a solution of 1 : 1000 bichloride of mercury (to prevent absorption of the bichloride an Esmarch bandage is always placed on the limb). In the majority of cases the wound is closed ; in very virulent cases the wound should be left open, but without drainage. So far in my experience we have never had to open a joint a second time, and even in the cases in which the wound was left open it has always closed rapidly, and

<sup>1</sup> *Deutsche Zeitschrift für Chirurgie*, April, 1899, Band li., Heft 3 and 4.

<sup>2</sup> *Ibid.*

it has not been necessary to wash the joint out again. Our arthrotomies have been performed chiefly on the knee-joint, but in a few cases on the ankle, elbow, and wrist. I should not hesitate, however, to open and irrigate the hip-joint through an anterior incision if the signs of distention of the capsule were present, and aspiration revealed the presence of the gonococcus in the effusion. When the effusion is sterile we depend upon non-operative measures—heat or cold. When the effusion contains a few gonococci, but is only slightly cloudy, aspiration is first performed; if this is not followed by relief in twenty-four to forty-eight hours arthrotomy is done.

**Charcot's Joints: Operative Treatment.** I have frequently thought that many cases suffering from the disability produced by advanced tabetic osteo-arthritis might be given a more useful limb by operative procedures.

A patient seen very recently in Professor Osler's wards, for whom I suggested an excision of the diseased knee-joint, stimulated me to investigate the literature, and I was rewarded by finding a recent article by Lotheissen,<sup>1</sup> who states that although 200 cases of Charcot's joints have been reported, and although at least 10 per cent. of tabetic patients have arthritis, very little has been attempted by surgical intervention.

Rotter,<sup>2</sup> in his classical article, has collected 112 arthropathies occurring in seventy-two patients. This article deals chiefly with the medical and pathological side, but Rotter records four operative cases—one hip, one ankle, and two knee-joints. As to surgical treatment, he does not refer to any previous literature. The results after the excision of the hip and ankle were excellent. The wounds healed per primam, and the use of the limb was greatly increased. He did not observe after the excision any evidence of proliferating osteitis at the ends of the bones, nor in observations of over one year was there any recurrence of the pathological changes about the excised joints. The ultimate results, however, as to the union of the bones after the two cases of excision of the knee-joint are not stated. The operations were recent.

The case reported by Lotheissen<sup>3</sup> was a resection of the hip. At the operation the head and neck of the femur were found almost completely disintegrated, and the capsule of the joint was completely destroyed. The symptoms were of a pathological dislocation or fracture. Lotheissen refers to two other cases of excision of the hip—Rotter<sup>4</sup> and Von Bergman. In these two cases the excision was performed because of a pathological dislocation. It is noted that there was very little destruction of the head, neck, or shaft of the femur, and not much change in

<sup>1</sup> Beiträge zur klinische Chirurgie, 1898, Band xxii.

<sup>2</sup> Archiv für klinische Chirurgie, 1887, Band xxxvi.

<sup>3</sup> Op. cit.

<sup>4</sup> Op. cit.

the synovial membrane. Dislocation was due, however, to the distention of the capsule with fluid and the stretching of the ligaments. A third case was operated upon by Schede. The indication was an acute infection, and the operation consisted of incision and drainage. Excision was not done. One year later Schede operated a second time and removed a sequestrum. The results of these four cases were excellent. That good bony union is possible and probable in the majority of cases we may infer from our knowledge of the healing of fractures in tabetic patients. Mr. Clutton<sup>1</sup> states: "Union (after fracture) generally, but by no means always, occurs in about the usual time, and often with excessive callus; refracture may follow feeble union." Rotter<sup>2</sup> believes union without excess of callus takes place in the majority of cases of fracture properly treated.

As to the surgical treatment of Charcot's joints, Lotheissen suggests the following methods:

1. Massage and tight bandaging, which give excellent results when the œdema is excessive.

2. In slight cases improvement has followed the use of a supporting apparatus.

3. Joint effusions should be aspirated.

4. Arthrotomy and permanent irrigation have given excellent results in three cases.

5. In advanced cases amputation or excision of the joints is indicated and will give excellent results.

The object of surgical intervention in tabetic joints is to give improved function to the limb when it is impaired or made practically useless by the pathological changes in the joint. Operation is, of course, useless when the tabetic symptoms are very far advanced; but it is to be remembered that arthritis is one of the early manifestations of tabes, and in many cases the pathological changes in the joints advance so rapidly that the function of the limb is soon very much impaired. The arthritis, especially of a severe grade, is commonly monarticular. This is especially true when one of the joints of a lower extremity is involved. Surgical procedures, as arthrotomy, with permanent drainage, excision, or amputation, seem to promise a great improvement in the ability of the patient to use the affected limb, and, I believe, should be more often followed.

Amputation so far has been the most common operation, usually of the thigh, for arthritis of the knee, and not uncommonly of the leg for arthritis of the ankle. In all of these cases the wounds have healed satisfactorily and locomotion has been improved.

<sup>1</sup> Treves' Surgery, 1895.

<sup>2</sup> Loc. cit.

Southham<sup>1</sup> reports a case of amputation of the leg. His patient was in a very advanced stage of the disease, and the ankle-joint was completely disorganized. Southham hesitated to amputate, fearing the healing process would not be good, because his experience had been very unsatisfactory after amputations for perforating ulcer of the foot in tabetic patients. He was, however, encouraged by an article by Jonathan Hutchinson.<sup>2</sup> Hutchinson reported a perfect healing after the amputation for a Charcot joint. The healing of the wound was perfect in Southham's case, and later he amputated in three other cases, with equally good results.

I have had no experience with operations on tabetic patients except a number of cases of complete excision of hemorrhoids and one case of partial amputation of the foot for perforating ulcer. The wounds in all these patients healed as perfectly as in any other subject.

The observations of Rotter, Lotheissen, Hutchinson, and Southham have established the fact that the healing of the wound after amputation and excision will be satisfactory in tabetic patients, and that the results after excision of joints in which bony union is not wished for will be excellent. However, we cannot at this time find any positive evidence for or against the possibility of bony union after resection of the knee. Of this most important point neither Rotter nor Lotheissen give any definite statements. The ultimate results of the ten cases of excision of the knee for Charcot's arthritis must be looked into more carefully before a definite conclusion can be given.

On July 6, 1899, I excised the knee of the patient mentioned in the introduction of this subject. The skin incision was made after local anæsthesia with cocaine, and the remainder of the excision was painlessly performed without any anæsthesia, local or general. The pathological changes were confined chiefly to the cartilage and soft parts. The spongiosa of the femur and tibia were slightly osteosclerotic rather than osteoporotic. The large wound healed perfectly, and now (November, 1899) I find the result has been a perfect one. A few weeks later Dr. Finney resected and wired an ununited fracture of the femur in a tabetic patient. The non-union was due to an overriding of the fragments, which in addition were separated by muscle; at the present time (November) there has been no bony union.

**Dislocation in Syringomyelia.** There is a great deal of literature on the arthropathies associated with syringomyelia and other lesions of the nervous system. With this every surgeon should be familiar, as a differential diagnosis of joint conditions is one of the most important of

<sup>1</sup> *Lancet*, November 12, 1892, vol. ii. p. 1261.

<sup>2</sup> *Archives of Surgery*, October, 1891, p. 137.



his duties. Each year more and more cases of diseases of joints come to the surgeon for diagnosis and treatment. In reference to syringomyelia, I will refer only to Schrader's<sup>1</sup> contributions (from the Tübingen clinic of Professor von Bruns) in regard to habitual luxation of the shoulder-joint associated with syringomyelia. Schrader reports two cases from Bruns' clinic, and has collected thirteen cases from the literature, in which a subluxation of the shoulder-joint was associated with syringomyelia.

These cases are of interest and importance to the surgeon, because frequently the luxation takes place before the symptoms of syringomyelia are far advanced. Unless it is borne in mind one might not recognize the neurotic etiology of the luxation before him. The habitual subluxation of the shoulder-joint associated with syringomyelia has not been dwelt upon before with any emphasis in the literature. Schrader's two cases, one a female, aged thirty-five years, and the other a male, aged fifty-two years, were very much alike. For some years there had been signs of syringomyelia; frequent attacks of panaris of the fingers of the left hand, associated with complete or partial loss of sensation of the left hand, arm, and part of the left side of the body, and slight kyphoscoliosis. In the case of the woman, the first luxation of the shoulder was due directly to injury. Following this there were frequent attacks, and when the patient presented herself to the clinic complete luxation of the head of the humerus, both forward and backward, was possible by the examining surgeon, as well as by the patient. The cause of this luxation was not recognized until the patient presented herself to Bruns' clinic. In the male patient no history could be ascertained of traumatism. The luxation seemed to be a typical pathological one. Preceding the luxation there had been pain in the shoulder, a grating sensation, and some loss of power. When the patient was examined there was swelling, and it was possible to luxate the head of the bone, both anterior and posterior, by passive motion; when the bone moved out of its place there was distinct crepitation, and it gave the patient some pain. The patient was not able, however, to produce luxation. X-ray photographs taken of both cases demonstrated the pathological condition.

Schrader, in summarizing these fifteen cases, finds that in six there was direct trauma which produced the first luxation; in five cases there was no history of trauma; it was evidently a spontaneous pathological dislocation, and in four cases there is no note. In the majority of cases the luxation took place very early in the disease.

The pathological changes consisted in widening of the capsule of the joint, 1 case; effusion into the capsule of the joint, 6 cases; atrophy of

<sup>1</sup> Beiträge zur klinische Chirurgie, 1899, Band xxiii., Heft 1.

the head, 4 cases; hypertrophy of the head, 2 cases; enlargement of the glenoid cavity, 3 cases; widening of the glenoid cavity, 1 case; exostosis, 2 cases; hypertrophy of the villi in the joint capsule, 1 case; in no cases were free-joint bodies found.

THE PROGNOSIS is bad, and there is practically no surgical treatment as yet suggested which is of any value. In two cases resection of the joint has been performed. The ultimate result in these two cases, however, is not stated. The disease is chiefly of interest from a point of differential diagnosis. In every case of habitual luxation of the shoulder-

FIG. 18.



Humerus and scapula of the right side. The head of the humerus has been destroyed. The glenoid surface of the scapula is enlarged and its edges are thickened by bony deposit. The coracoid process presents peripheral accretions. (DERCUM.)

joint one should look for symptoms of syringomyelia. The thirteenth case of Schrader is reported by Dercum and Spiller.<sup>1</sup> In this case the head and upper part of the shaft of the humerus were entirely gone (Fig. 18).

**Joints: Free Bodies.** The etiology of free-joint bodies has been under discussion for many years. The chief question in the controversy has been with regard to the pure traumatic origin. It seems that the

<sup>1</sup> American Journal of the Medical Sciences, vol. cxii. p. 672.

majority of authorities have not agreed that these loose cartilages could all be explained by a simple traumatic separation of the articular surface of the bone, but believe that with or without preceding trauma there was a definite pathological change (some form of necrosis) which preceded the separation of the cartilage. Two recent articles by Barth<sup>1</sup> and Vollbrecht<sup>2</sup> are very convincing that the etiology of the free hard-joint bodies is a pure traumatic separation. Barth's contribution is the most complete, and in a review of the literature he calls attention to the fact that Monroe, in 1726, showed that in the majority of joint bodies, free and pedunculated, he was able to find a corresponding defect in the articular cartilage surface of the joint, and advocated the pure traumatic origin. Laennec, however, in 1813, considered that these joint bodies were a product of the parsynovial connective tissue. Broca, in 1854, believed that the single or repeated trauma produced a disturbance of the circulation in the cartilage of the joint surface, and that a line of separation was formed by necrosis without suppuration. König believes that the separation of the free body is due to a pathological process, which he calls *osteocondritis dissecans*.

Barth divides joint bodies into two forms: (1) The soft bodies, which are due to the degeneration of the synovial membrane or to precipitates from the synovial fluid. This form is known as the rice-joint body, and is seen commonly in tuberculosis and rarely in arthritis deformans. (2) The hard cartilaginous bodies, the origin of which Barth believes is due only to two causes: (a) Traumatic separation and (b) arthritis deformans. Barth in his article considers only the hard bodies due to traumatic separation. He states, however, that Broca's explanation of a spontaneous necrosis is true for the etiology of these bodies in arthritis deformans. Barth bases his assumption of the pure traumatic origin on animal experiments and on the histological picture of the body itself.

He demonstrated in animal experiments that the body which was separated from the joint surface by a gouge or chisel always became attached to the capsule of the joint. In the majority of cases this body was absorbed within three months. In a few cases it became pedunculated and did not go on to absorption. He has been able to demonstrate that when these bodies became attached to the synovial membrane of the joint their hyaline cartilage retained its vitality and preserved the normal appearance of articular cartilage. The bone underwent necrosis. The vitality of the body was preserved through tissue connecting it with the capsule of the joint. He demonstrated that there was always a thin connective tissue envelope formed around the joint body; that the old

<sup>1</sup> Archiv für klinische Chirurgie, 1898, Band lvi., Heft 3.

<sup>2</sup> Beiträge zur klinische Chirurgie, 1898, vol. xxi.

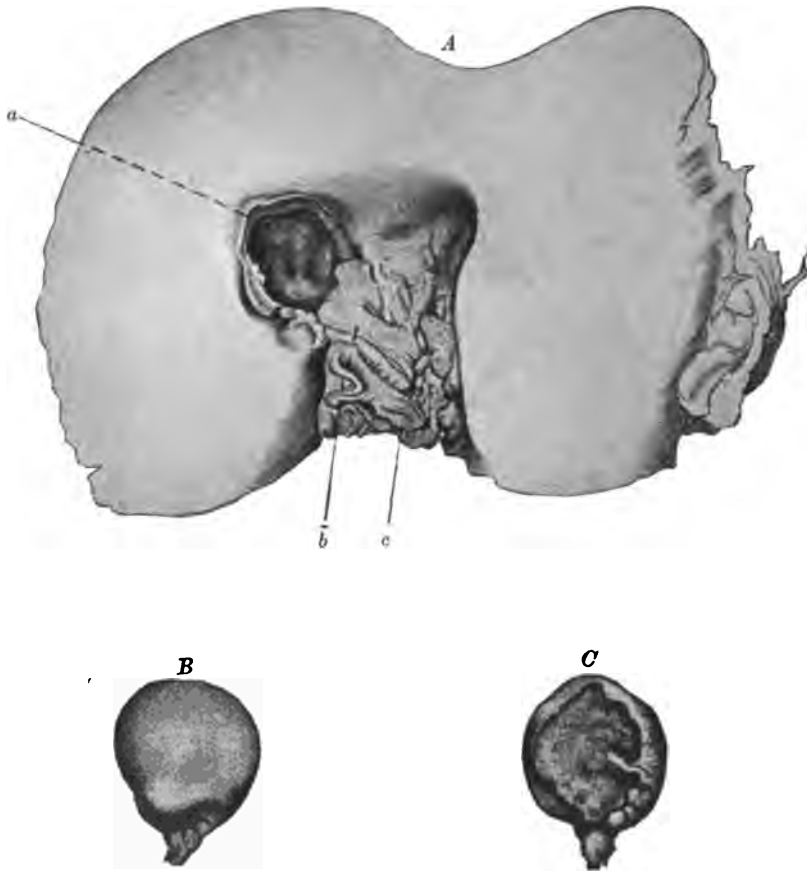
necrotic bone-area was, as a rule, replaced by new bone or cartilage, and that the fractured surface of the joint body was covered with a narrow envelope of new cartilage, which extended not only over the fractured bone-surface but over the fractured cartilage surface. This new cartilage differed histologically from the hyaline articular cartilage of the free body, and had the appearance of growing embryonic cartilage. He was able to demonstrate in animals, then, that detached pieces of the articular surface of joints showed a uniform histological appearance. Of the original tissue the hyaline cartilage of the articular surface of the joint body retained its vitality. The bone, however, became necrotic. Through this attachment of the joint capsule the joint body received an envelope of new connective tissue and over its fractured surface an envelope of new embryonic cartilage, and the necrotic bone-space was infiltrated by new bone and cartilage cells.

In his observations on loose bodies in man, he found in a few of his cases that the bodies were attached, and such bodies had the same histological appearance as those produced experimentally in dogs. He believes, however, that the majority of, if not all, free bodies have at some time an attachment to the joint capsule, and through this attachment they receive the connective tissue envelope and the envelope of new cartilage on the fracture surface. In man, because the connection between the body and the joint capsule is either of shorter duration or of less vascular tissue, the infiltration of new bone into the necrotic old bone-area is always less, and on account of the poorer circulation through its capsular pedicle there is always found a good deal of calcification. In all of his joint bodies he was able to demonstrate, on the smooth convex surface, the normal hyaline cartilage of the articular surface, an envelope of connective tissue, and on the fractured surface an envelope of new embryonic cartilage. The bone-area, if present, always showed necrosis. In a few (those that had pedicles) there was a slight infiltration of new bone into this necrotic area. In all, and most marked in the older and free bodies, calcification was present. In the majority of cases he was able to get a history of traumatism; in many of the cases the defect in the articular surface of one of the bones was demonstrated.

Studying this defect both in the animal experiments and, when possible, in the human being, he found that the defect in the articular surface was covered with a new envelope of embryonic cartilage similar to that covering the fractured surface of the free body. In view of the fact that slight trauma may produce this separation, a traumatic history is not obtained in some of the cases, because the patients frequently forget the slight injury. He believes that these histological findings in animal experiments in hard-joint bodies demonstrate positively the absence of any pathological changes (the osteochondritis dissecans of König, or the dry

necrosis of Paget, or the spontaneous necrosis of Broca); but that these bodies are all produced by a simple traumatic separation; that the hyaline cartilage of the free-joint body retains its vitality and the bone undergoes necrosis, and that the new issue which is found about the joint body is the product of the connective tissue attachment to the joint capsule, which is present at some period during its life, and later this becomes a fine pedicle or there is a complete separation.

FIG. 19.



A. Condyle of femur. a. Defect. b. Crucial ligament. c. Fossa interna. B. Smooth surface of body. C. Fractured surface.

The first case which he published in the *Centralblatt für Chirurgie*, 1895, No. 43, was as clear in its traumatic clinical history, in its histological findings, and in the presence of a defect in the articular surface of the joint as in any of his animal experiments. Barth reports in detail, with careful histological studies, nine cases. Including his cases

he has found in the literature: In the shoulder-joint, 2 cases; in the elbow-joint, 8 cases (including two of his own); in the wrist-joint, 1 case; in the knee-joint, 55 cases (including eight of his own).

It is interesting to note, from a diagnostic stand-point, that in one of his own cases a diagnosis of tuberculosis of the joint was made. At first the treatment consisted of iodoform injections, and, as improvement did not follow, an exploratory arthrotomy was performed; and the operator, considering the appearance of the synovial membrane one of tuberculosis, excised the knee-joint. Barth examined the tissues. There was no evidence whatever of tuberculosis; there was a free-joint body with a corresponding defect in the internal condyle of the femur (Fig. 19). A histological study of the body itself and the surface of the defect corresponded to the usual findings, which we have already discussed.

It is interesting to note that in one case the loose body in the knee came from the head of the tibia.

In the majority of these cases the clinical history is as follows: Following a slight trauma to a joint, most commonly the knee, the patient suffers for a few days or a week or more with pain and slight restriction of motion, chiefly flexion. Effusion into the joint is also noted, but an apparent perfect recovery follows. Later (a few months, and in some cases years) pain returns; there may be recurrent attacks of effusion with restricted motion, and then the free-joint body is, as a rule, easily felt.

It is therefore most important for surgeons to always remember that a free or pedunculated joint body may be the cause of an obscure case of arthritis. As a rule, the bodies are single, now and then they may be multiple; perfect recovery always follows their removal.

Vollbrecht's cases are from Mikulicz's clinic. He reports 63. In 40 cases he was able to get a history of traumatism; in 23 cases he was unable to get such a history. He states that the loose-joint body in cases of arthritis deformans is of a different histological structure than the one due to traumatic separation. He finds in the traumatic joint body the same histological picture described by Barth, and was unable to demonstrate either in the body itself or in the defect (when he was able to study it) the pathological changes described by König. These two articles seem to solve the question of the etiology of free-joint bodies in favor of a pure traumatic separation.

In the operation for the removal of a free-joint body, as in any arthrotomy of a clean joint, the most important point is the surgical technique. In addition to all the other surgical precautions, I believe the operator and every assistant should wear rubber gloves. The size of the opening into the joint, as far as my observations have gone, is of no importance. There is no danger in making a large opening to

remove the body, and through which to examine the joint surfaces for the defect. In Professor Halsted's clinic we have closed the synovial membrane with interrupted sutures of fine black silk, approximated the divided capsule of the joint with heavier silk, catgut, or fine silver wire, and closed the skin with the usual continued subcutaneous suture of silver wire. In every case the wound has healed per primam, and there has been no restriction in motion of the joint following operation.

Professor König,<sup>1</sup> of Berlin, in a very recent publication, still advocates his pathological basis (osteochondritis dissecans) of joint bodies, which he first described in 1887.<sup>2</sup> This publication, which was read before the last Congress of German Surgeons, is based on an observation during twenty years and of seventy specimens of joint bodies. Of 60 cases of joint bodies in the knee and elbow-joints, 16 were of a purely traumatic origin, 8 were associated with arthritis deformans, and 36 (19 knee and 17 elbow) were due to osteochondritis dissecans. Among these 36 cases there were 48 joint bodies, 21 attached and 27 free.

This pathological process, König admits, is still somewhat mysterious and not completely established. The observations were made at the operation on thirty-six joints, and, as König remarks, the inspection was somewhat similar in scope and clearness to that of a room from a peep through the keyhole. Arthritis deformans was excluded, because the disease is easily recognized through even this small incision, and the subsequent examinations of the patients have not shown any positive signs. König's theory is based on the gross appearance of the defect, in a few cases on the histological study of a small piece removed from this defect, and on observations of the joint body itself. König proposes to publish later an article of greater detail.

**Subluxation of the Semilunar Cartilages of the Knee.** Surgeons are not often called to see this condition early in the first attack. It is only after many attacks and a number of years that patients come for surgical treatment. Graham<sup>3</sup> states, however, that he has seen a few cases of subluxation a short time after the first injury. He was able to recognize the condition by the inability to fully extend the leg and the palpation of the cartilage, which protruded slightly from the joint. He states that in these cases reduction has been easily accomplished. One flexes and then suddenly extends the leg, at the same time rotating the leg outward if the subluxation is of the internal semilunar cartilage, and rotating it inward if it is the external semilunar cartilage.

Pauzat<sup>4</sup> states that he has been able to make a diagnosis of a recent

<sup>1</sup> Archiv für klinische Chirurgie, 1899, Band lix., Heft 1.

<sup>2</sup> Deutsche Zeitschrift für Chirurgie, 1887.

<sup>3</sup> American Journal of the Medical Sciences, November, 1896.

<sup>4</sup> Revue de Chirurgie, February, 1895.

subluxation by the appearance of subcutaneous ecchymosis, pain on pressure, and the projection of the meniscus. He states that reduction has always been easily accomplished.

Shaffer,<sup>1</sup> in a series of eleven cases, has observed one early case (Case IX.). He says: "This is the only case in which I have actually seen and felt the dislocated cartilage, my other patients coming long after the original injury." This patient was twenty years of age, and sent for Shaffer a few hours after the accident. She stated that in turning over in bed early in the morning something had snapped in the knee, which had become locked; it became at once very painful, and there was swelling. Shaffer was able to distinctly feel the dislocated internal semilunar cartilage of the left knee. "Flexing the knee, with some difficulty and pain, to about a right angle and rotating the tibia outward, I gradually manipulated the dislocated cartilage into its normal position, with immediate relief to all the painful symptoms. After this the knee-joint became immediately movable, *except that it could not be fully extended*. After a few days the swelling had entirely disappeared and the patient resumed her ordinary exercises." The ultimate result is not noted in this case. With regard to the diagnosis in the older cases the history is very suggestive. It does not differ much, however, from that obtained when the trouble is due to a loose body, and in some cases to a lipomata, which will be referred to. (See p. 213.) Shaffer<sup>2</sup> emphasizes, however, a very important and characteristic condition, which seems to be almost pathognomonic of a dislocation of the meniscus. He states, in looking over the notes of his previous cases, that he found eight in which the histories were pretty complete. In these eight the following conditions were present: (1) A very considerable lateral mobility of the joint; (2) an elongated ligamentum patella, and (3) in six of the cases an inability to completely extend the knee. This inability to completely extend the knee seems to be characteristic in subluxation of the meniscus and a very important observation in diagnosis. In the four cases which I have observed in Dr. Halsted's clinic this condition noted by Shaffer has been present. It was most characteristic in a case observed a few days ago. The patient states that two years previously, after jumping off a freight car, he felt a sudden, sharp pain in the inner side of the left knee, and found that he was standing with this knee slightly flexed, and that he was unable to extend it. The pain and the inability to extend the knee disappeared in a few moments. During the next three weeks, especially after any quick motion of the limb, he had similar recurrent attacks. At the end of three weeks he noticed that the knee was swollen a little, and at the advice of his physician went to bed and gave the knee rest

<sup>1</sup> Annals of Surgery, 1898, vol. xxviii.

<sup>2</sup> Ibid.



for a couple of weeks. Since this treatment he has had no recurrence of this sudden attack of pain with locking of the joint, but he has found that whenever he walks beyond a certain distance the knee begins to give him pain and there is some little swelling. For this reason he has always kept himself within limits and has been especially careful in quick motions. On examination there is little difference to be made out between the two knees. However, when the patient is lying on his back and he is asked to flex the leg at the knee and to raise the foot from the cot, he is able to extend the right leg with great ease; he is unable, however, to completely extend the left leg except now and then, when with a quick, jerking motion of the quadriceps he brings the leg into full extension. He has noticed this himself. On careful comparison by palpation of the internal meniscus of the two knees I was able to make out slight mobility of the one on the left.

Vollbrecht<sup>1</sup> has given us an excellent article on subluxation of the semilunar cartilages. He reports somewhat in detail eleven cases, eight of the internal and three of the external meniscus. As regards the pathology of the subluxation his observations confirm those of Bruns,<sup>2</sup> who objects to the term "internal derangement of the knee-joint," given to this condition by Hey, in 1803, because it is indefinite, and thinks that the term "subluxation of the internal or external meniscus or semilunar cartilage" a better and more definite one. He has observed that with the subluxation there is rupture of the anterior or posterior attachment of the semilunar cartilage, most commonly of the anterior and rarely of the posterior. Both attachments have never been observed to be ruptured at the same time. Now and then the rupture, or, better, a loosening, was confined to the lateral attachment of the cartilage. The internal meniscus is the cartilage most commonly involved. Complete luxation has never been observed. He speaks of traumatic luxation due to direct, rarely, and indirect force, commonly; of a spontaneous luxation in cases in which he believes there is an individual predisposition due to some anatomical weakness. He has not observed pathological subluxations of the meniscus. The meniscus may be almost completely destroyed by the recurring luxations.

**DIAGNOSIS.** The early diagnosis and treatment have been referred to. As a rule, if seen early, on account of the slight effusion, pain, and swelling, a diagnosis of traumatic synovitis with effusion is made, and the patient is treated with rest, etc., and the condition is not recognized until after a number of attacks. Recurrent attacks of synovitis and effusion are not uncommon; and now and then cases may be

<sup>1</sup> Beiträge zur klinische Chirurgie, 1898, vol. xxi.

<sup>2</sup> Ibid., 1898, Band xix., Heft 2.

mistaken for early tuberculosis or other forms of arthritis. I believe that the inability to fully extend the leg in an otherwise apparently perfectly normal and movable joint is an important diagnostic point. In the recurrent cases one is not always able to palpate or to demonstrate the abnormal mobility of the meniscus; but when this can be ascertained it differs distinctly from that of a free-joint body, in that the semilunar cartilage is constant in its position.

**TREATMENT.** In the first attack all authorities agree that if the meniscus has not reduced itself the reduction should be accomplished by the method advocated by Graham and the joint placed in rest for a few days or a week. In the recurrent attacks which are giving the patients sufficient discomfort to force them to seek some surgical intervention, we can offer to them two methods of treatment: the use of an apparatus or the operative treatment. Shaffer<sup>1</sup> unquestionably gives us the best method of an orthopedic appliance. He states: "From a study of this in my previous cases, it seems to me that the indications from an orthopedic stand-point are: (1) To correct the lateral mobility of the knee; (2) to prevent rotation of the tibia upon the femur; (3) to so arrange the apparatus that the extension of the knee will stop at a point where the traumatism of locomotion would cease to exist—that is, at a point where pain and discomfort would wholly be eliminated. This means an apparatus with simple anterior and posterior motion, extending from the anterior third of the thigh to the sole of the foot, with the joint at the knee and the ankle, the former having a mechanism by which extension would stop at a desired point." Figs. 20, 21, and 22 are good illustrations of this apparatus. I find in studying carefully ten cases in which Shaffer has used this apparatus, that in five cases the patients are still wearing an apparatus, from a few months to two years. The first case in which he used the apparatus, in 1892, it was discarded in about a year, and it is stated that the patient is perfectly well, though the date of the last observation is not recorded. In the second case the apparatus was worn two years, and I should judge, although it is not distinctly stated, that at the date his article was written, in 1898, four years after the apparatus was removed, the patient has had no recurrence of the trouble. If this is correct this patient demonstrates a perfect result in a period of four years. In the other cases it has been within a year since the apparatus was removed, and so far there has been no recurrence of the trouble. In this small series of cases Shaffer has demonstrated that the apparatus can be worn with considerable comfort, and that after periods varying from six months to two years it can be removed; so far in the cases observed, although they are not many,

<sup>1</sup> *Annals of Surgery*, 1898, vol. xxviii.

the trouble has not returned. He has noted in a number of cases, after a certain number of months of treatment, that the lengthening of the patella ligament was reduced, and that the ability to fully extend the leg partly or completely returned. The observations on this point are not concise in every case.

FIG. 20.



FIG. 21.



FIG. 20.—Shaffer's apparatus for Hey's joint; antero-posterior motion only at knee and ankle.

FIG. 21.—Shaffer's apparatus for Hey's joint applied; lateral view, showing "stop-joint" at knee.

Shaffer, however, recommends in very severe cases, and in cases in which the apparatus has failed, *operation*. As to operation, we have

two methods—a complete or partial excision of the dislocated or injured meniscus, or suture. Barker<sup>1</sup> reports six cases of recurrent dislocation which so far have been cured by suture. He differs from Vollbrecht and Bruns in admitting a complete dislocation of the meniscus. March<sup>2</sup> reports twelve cases of excision of the cartilage, with excellent

FIG. 22.



Shaffer's apparatus for Hey's joint applied, showing protection pad inside of knee.

results. In the cases reported, the Bruns and Vollbrecht excision, either complete or partial, has been the method of operation. As far as I can ascertain from the history of these cases the result, both of excision and suture, has been equally perfect, and many cases have been observed over periods of two to five years.

Walker<sup>3</sup> states that the prognosis after operation is good, for after a careful study of the literature covering the past five years, including 100 cases, there has not been found a reported case of death following these operations. Walker, in his article, reports six cases operated on by Bull and Gibney.

Barrow<sup>4</sup> reports a case of removal of the internal meniscus, "In which at the operation to expose the cartilage the ligament patella was divided and the bone turned up. When the joint was opened the internal semilunar fibrocartilage was found to be detached from the tibia throughout most of its extent, especially in front and at its side and folded upon itself. The cartilage looked like the twisted mass of fibrous tissue. It was completely removed. The ligament patella was sutured and the wound closed without drainage." The immediate and ultimate result has been perfect.

Although successful in this case reported by Mr. Barrow, I do not think that it is necessary in operations for subluxation of the meniscus to divide the ligament patella. The cartilage is easily exposed by an incision directly over it and opening the joint above it. One is then able to make out the position and extent of the rupture and the position

<sup>1</sup> Lancet, September, 1897.

<sup>2</sup> Medical News, June 14, 1899.

<sup>3</sup> British Medical Journal, March 5, 1898.

<sup>4</sup> Lancet, February 18, 1899.

of the cartilage itself. Unless the cartilage is not in good condition, and if its separation from the tibia is not too extensive, I believe that a suture is the operation of choice. We have followed this in two cases. In the case in which I operated on, before suture of the cartilage to the tibia, I chiselled the bone, in order to make a fresh surface, thinking that union between the cartilage and chiselled bone would be stronger. In the second case operated on by Dr. Finney the surface of the tibia was not chiselled. The ultimate results in these two cases have been equally good, the period of observation being about two years. When, however, the cartilage is twisted and out of shape and of a peculiar ashy-gray color, and when its attachments have been extensively torn, it should be completely or partially removed. This was the case in a third patient operated on by Professor Halsted. The ultimate result in this case, over a period of three years, has been perfect.

We now have, therefore, sufficient positive evidence that the operative treatment of subluxation of the meniscus of the knee will yield excellent results, that the patients will be relieved of those annoying recurrent attacks, and after the operation will not, as far as we can find out, be incapacitated for any sort of labor. However, when the surgeon informs a patient of the excellent results after operation, he should mention to him the possibility that an apparatus (the one advised by Shaffer being the best) may, after a period of from six months to two years, give him an equally good result.

**Joints: Lipomata.** It is important in the differential diagnosis of swellings about the knee-joint to bear in mind the possibility of the joint lipomata. They are not common; but every now and then one is happily surprised in making an exploratory incision into a tumor about a joint to find that it is a lipoma. Bischitzky,<sup>1</sup> writing from observation in Wölffler's clinic, considers a case of subserous lipoma of the elbow-joint which in some respects differs from the ordinary joint lipomata. In reporting this case he gives an interesting résumé of our knowledge of this subject. Most of us are familiar with the ordinary lipoma arborescens, which was first described by Johannes Müller, who considered it a hypertrophy of the normal fat villi in the joint and not a true tumor.

The other form of joint lipomata arises generally from areas of normal fat lying in some place outside the synovial membrane. They are called the subserous joint lipomata, and König compares them to the subserous lipomata of other serous membranes, such as the peritoneum and the pleura. It is interesting to note that König and others believe that these tumors come from pre-existing areas of fat, that about different joints these areas occupy certain definite anatomical positions, and that

<sup>1</sup> Beiträge zur klinische Chirurgie, 1899, Band xxiii.

very different causes may give rise to the tumors. Traumatism and pressure from muscle-pull seem to be the two chief causes which influence hypertrophy in these areas of fat. In the majority of cases the tumor extends into the joint, carrying with it a covering of serous membrane, and now and then it becomes pedunculated. The lipoma may extend into the joint proper through a tear in the synovial membrane.

In Bischitzky's case the patient was a man, aged forty-five years, who for three years had noticed a swelling in the elbow-joint. Previous to this and during three years he had been doing very hard manual labor, in which the forearm was flexed and extended at frequent intervals. The tumor at first was the size of a walnut and the growth was slow. There was no pain. The only symptom which bothered the patient was his inability to completely flex the elbow. On examination a swelling in the elbow on both sides of the biceps muscle was found. The skin was normal and had all the characteristics of a benign tumor, probably lipoma. At operation one tumor was found between the flexor muscles and the brachialis anticus, and it was continuous with a small amount of fat attached to the anterior capsule of the elbow-joint. On the radial side there was a similar tumor situated between the supinator longus and the flexor carpi radialis and brachialis anticus. This tumor had a similar relation to the anterior capsule of the joint. It differed from other subserous lipomata in that it projected outward between the muscles about the joint and not inward into the joint cavity. In order to demonstrate whether these tumors originated from pre-existing areas of fat, Bischitzky made a few dissections of the elbow-joint, and found that there were two small areas of fat—one situated in front of the head of the radius and a second in front of the coronoid process of the ulnar to the inner side of the attachment of the brachialis anticus. This area of fat was attached to the capsule of the joint. Therefore, he was able to demonstrate that these two tumors originated from small islands of fat, which are to be found normally about the elbow-joint.

I have observed two interesting cases of lipomata of the joint, one being situated behind and slightly below the external malleolus of the fibula. At operation it was found that the tendons of the perineal muscles were situated over the posterior and lower side of the tumor, being pushed backward and away from the joint by the mass of fat. Fat was attached to the synovial membrane of the ankle-joint, but projected outward and not inward. The tumor had been noticed for six or eight months, and had given a good deal of pain. The only explanation that could be given for the hypertrophy of the fat was the fact that the patient was suffering from a fracture of the patella, and for the last eighteen months the affected leg had been bearing most of the weight of the body. The second case I observed in the dispensary with Dr. Finney. It was an interesting

example of the *lipomata arborescens*. The patient was a young woman who some three months before had received a perforating wound of the middle phalangeal joint of the index finger. The wound, she said, healed slowly. Some weeks after it had completely healed she noticed that the joint began to swell slowly. It was a little painful, and motion was almost completely restricted. The joint was found to be uniformly swollen, the conformity of the finger was spindle-shaped, the tissues were boggy and had the appearance of tuberculosis. At the operation Dr. Finney found that the entire joint cavity was filled with fat. The fat was slightly vascular and there was some excess of connective tissue in places. There was no evidence of suppuration; the synovial membrane was completely destroyed and replaced by this *lipoma arborescens*. The tumor tissue was all excised, the wound was closed, and the function of the joint was completely restored.

### OSTEOMALACIA.

**Osteomalacia in Children and Men.** Oppenheimer's<sup>1</sup> statement that 91 per cent. of cases have been observed in women, and of these 70 per cent. were pregnant, has influenced most clinicians to exclude osteomalacia in a differential diagnosis of disease of the bones in children and men, and especially in this country, where osteomalacia is very rare. Two recent articles by Siegert<sup>2</sup> and Ringel<sup>3</sup> are suggestive that even in this country we may be overlooking cases of osteomalacia in children and men, as has occurred in countries where the disease is endemic.

Siegert reports a case of osteomalacia in a child and Ringel one in a man, and both discuss the recent views as to the etiology and differential diagnosis.

Siegert is positive in a statement that phosphorus is specific in osteomalacia and of no value in rickets—the chief disease from which osteomalacia, both in children and adults (late rickets), must be differentiated. Bernstein<sup>4</sup> also reports a case in which the administration of phosphorus was followed by improvement when oophorin in large doses had failed.

That some cases of osteomalacia in women recover without any specific treatment is shown by Durham's<sup>5</sup> statistics: 145 cases with 22 recoveries. All the cases which recovered, however, were associated with pregnancy.

Siegert's (and Heubner, quoted by Siegert) statement of the specific

<sup>1</sup> Treves' System of Surgery, 1895, vol. ii.

<sup>2</sup> Münchener med. Wochenschrift, November, 1898.

<sup>3</sup> Beiträge zur klinische Chirurgie, 1889, Band xxiii., Heft 2.

<sup>4</sup> Münchener med. Wochenschrift, April 5, 1898, p. 427.

<sup>5</sup> Guy's Hospital Reports, vol. x.

value and almost therapeutic test of phosphorus in osteomalacia cannot yet be accepted until further proof by a larger number of cases and a longer period of observation is given us.

Both Siegert and Ringel refer to Rehn's case of osteomalacia in a child. In 1878, Rehn found the skeleton of the child in the Senkenberg Institute. The anatomical examination was made by von Recklinghausen, who found typical osteomalacia of the bones, but no signs of rhachitis. In 1882, Rehn reported six other cases of osteomalacia in children. Even since the report of these cases by Rehn and von Recklinghausen the possibility of infantile osteomalacia has been questioned by most pathologists.

Siegert's case is of especial interest. The clinical diagnosis was not made. The autopsy was performed by von Recklinghausen and a diagnosis of typical infantile osteomalacia made. This patient, a boy aged nine years, first came under observation in June, 1887, and remained under observation until his death, nine years later. When first observed he was suffering from ascites and enlarged liver. Later the liver atrophied, but during the remainder of his life it was necessary to tap the abdomen at intervals. In 1893 (patient was now aged fifteen years—six years after the first observation and three years before death) the first symptoms of osteomalacia appeared. Without any special cause to be made out the boy complained of pain in the limbs and great weakness. During the following two years the pain continued and was referred also to the back, sternum, and head. The weakness of the limbs gradually increased until the patient became bedridden. After two and a half years slight deformities were noted, the most characteristic being the prominence of the sternum and a slight scoliosis. After three years kyphoscoliosis appeared. This occurred a few months before his death, which was attributed to cedema of the lungs. A complete autopsy was made by von Recklinghausen, with a positive diagnosis of infantile osteomalacia. Siegert has been able to find in the literature three other cases of infantile osteomalacia beside the six cases reported by Rehn and one case by Rehn and von Recklinghausen. A short sketch of these three cases will not, I am sure, be out of place. The symptoms and clinical history should enable one to make the diagnosis in future observations.

*Case I.* Collaz (1884). A girl, aged ten years, was first observed with a recent fracture of the femur. A short time previous there had been a fracture of the humerus, and in early infancy the child had suffered from rhachitis, but had made a complete recovery. The patient was emaciated, the long bones were soft and flexible, and the urine contained an excess of phosphates. The patient was observed for three years, and death took place from renal calculus and kidney infection. Shortly before death paraplegia had developed. At the autopsy soft



osteomaletic areas were found in the skull and in the bodies of the vertebræ. There was a marked kyphoscoliosis. The pelvic bones were soft and deformed; the right ilium was thickened, while the left was thin. The long bones were soft and bent. The histological examination of the bones showed the characteristic changes of osteomalacia. The case was considered by Collaz to be one of rickets. Siegert, however, considered it to be clinically and anatomically typical infantile osteomalacia.

*Case II.* Meslay and Peron (1896). A girl, aged thirteen years, apparently in perfect health, began somewhat suddenly to complain of pain and slight weakness in the limbs, which was most marked after exercise. At the end of a year and a half the patient was bedridden; there was a marked kyphoscoliosis. After two years there were spontaneous fractures of both femur and tibia. The patient died at the end of three years with œdema of the lungs. Menstruation had never taken place. Autopsy—typical osteomalacia.

*Case III.* Meslay (1897). This patient, a girl, had suffered from rickets at one year of age, but had made a perfect recovery. At thirteen years, when strong and in apparently good health, she began suddenly to suffer with pain in the legs and slight weakness, most marked after exercise. The weakness slowly increased until, after using crutches, the patient became bedridden. After three years in bed multiple spontaneous fractures occurred. Kyphoscoliosis was marked. Death took place nine years after the beginning of the symptoms (aged twenty-two years) from œdema of the lungs. This patient had never menstruated. Autopsy—typical osteomalacia.

Siegert is emphatic in his conclusion that these three cases are clinically and anatomically as typical osteomalacia as the one reported by himself, in which the autopsy was made by von Recklinghausen. The onset of the disease in these four cases began at nine, ten, thirteen, and sixteen years—one boy and three girls. The duration of the disease in two cases was three years, in one case six years, and in one, ten years. The most characteristic early symptoms were *pains* in the bones of the limbs; later, pain in the back, sternum, and head, not associated with any change in the bone itself; *weakness* in the lower extremities, which gradually increased, so that at first the patient walked with difficulty, first with a cane, later with crutches, and finally was bedridden; slowly developing kyphoscoliosis due (confirmed by autopsy) to softening of the vertebræ and not to tubercular osteomyelitis.

Ringel, in his article, gives reference to three cases of osteomalacia in children which are not referred to in Siegert's résumé; one by Elben, in 1882, in a girl, aged two years, and one by Bury, in a girl, aged eight months. Ringel, however, considers the diagnosis doubtful in these cases. He states that Strümpell and Ziegler consider the case of Rehn

and von Recklinghausen to be one of rickets and not one of osteomalacia. Ringel does not refer to any of the cases quoted by Siegert of infantile osteomalacia, except the one of Rehn.

AS TO OSTEOMALACIA IN MEN, Ringel refers to a case reported by Ellis of a man, aged fifty years, in whom the disease developed rapidly after a febrile attack. Death took place at the end of nine months from pneumonia. A partial autopsy only was performed, but definite softening of the bodies of the vertebræ and of the ribs was demonstrated.

Ringel's own patient was twenty-five years of age, and had been in excellent health up to a few months before he came to the hospital with symptoms of ulcer of the stomach. This patient was under observation for eleven years. The ultimate cause of death was hemorrhage from the gastric ulcer. During this period the symptoms of osteomalacia were very gradual: pain in the limbs, weakness, inability to walk without crutches, and finally, at the end of three and a half years, the patient was bedridden. Kyphoscoliosis was noted after four years, with a diagnosis of tuberculosis of the vertebra, and a plaster jacket was applied. At the autopsy typical osteomalacia was found to be present in most of the bones. The bodies of the vertebræ showed no evidence whatever of tubercular osteomyelitis, but only softening due to the histological and chemical changes of osteomalacia.

These observations of Siegert and Ringel, who report two typical cases of osteomalacia, one in a boy, nine years of age, and the other in a man, twenty-five years of age, in which in each case the diagnosis was confirmed by autopsy, and these observations strengthened by a collection of similar cases from the literature, especially those of Siegert, which are confirmed by careful autopsy report, seem to establish without a doubt the possibility of osteomalacia in children and adults. Siegert is very emphatic against the possibility of recurrent rickets. He states that in 1000 observations of infantile rickets he has never observed one single case of recurrence, and that in patients with a history of cured infantile rickets, with symptoms later in life suggesting a recurrence of the disease, one should be very suspicious of osteomalacia.

### OSTEOMYELITIS.

**Streptococcus Osteomyelitis.** E. Lexer<sup>1</sup> writes on early observations in streptococcus and pneumococcus osteomyelitis. He refers to his earlier article,<sup>2</sup> which considered the etiology and micro-organism of acute osteomyelitis, and states that in this paper he has collected the previous

<sup>1</sup> Archiv für klinische Chirurgie, Band lvii.

<sup>2</sup> Sammlung klinische Vorträge, v. Bagmann-Erb and Winkel, No. 173.

literature. With us, both streptococcus and pneumococcus osteomyelitis are very rare. All of Lexer's diagnoses are confirmed by careful cover-slip and culture observations and animal inoculation. The cases are fully reported and the description of the local disease in each case is unusually careful. As a few of the cases came to autopsy, we have in addition a more complete picture of the disease.

In a careful review of both recent and older literature, one is impressed with how little concerning osteomyelitis is to be found in both English and American journals. To the German and French writers we are chiefly indebted for our knowledge of the disease. The great advantage of these articles lies in the fact of the large number of cases observed: Von Bergmann (1895), 150 cases of acute osteomyelitis; Funke (1895), 664 cases of osteomyelitis; Lannelongue (1879), 100 cases under five years of age; Helferich, 141 cases; Haeger, 403 cases, and many others. In addition we find careful bacteriological reports and complete histories and descriptions of the pathological anatomy.

The recent literature is mostly concerned with the difference or similarity of osteomyelitis produced by other bacteria than the most common staphylococcus pyogenes aureus—chiefly the streptococcus, the pneumococcus, and the typhoid bacillus; the discussion as to the portal of entrance; the frequency in infants; the frequency with which acute arthritis of infants is secondary to an osteomyelitis, and reports of osteomyelitis situated in very uncommon localities—in the vertebræ and pubic bone.

Lexer divides his cases of streptococcus infection into three groups: 1. Those in which phlegmon was very marked in the affected bone and sequestration was found. 2. Those in which an acute arthritis was the predominant symptom, but in each case a focus of suppuration was demonstrated to be present in the bone. 3. Those cases of acute arthritis in which no bone lesion could be found.

The object of the first group of cases is to demonstrate that a streptococcus osteomyelitis resembles closely, both clinically and anatomically, a staphylococcus infection. Lannelongue, who was first to recognize and describe streptococcus osteomyelitis, recognized a difference, both clinically and (especially) anatomically. The streptococcus infection was usually situated more superficially, and produced subperiosteal inflammation, both of periosteum and of the cortical bone, and seldom attacked the medulla; sequestra were rare, and the formation of pus was scanty. Lexer, in his earlier article, with an observation on two cases, was inclined to agree with Lannelongue, but the cases reported in the second paper, with those observed by other surgeons, conclusively demonstrated that at least in some and perhaps all cases there is little if any difference in the clinical and anatomical characteristics of the two infections. The cases observed by Lexer and also by Perutz, of pneumococcus osteo-

myelitis, show that this organism produced the same clinical and anatomical picture. Perutz, however, calls attention to a very interesting clinical symptom which he thinks may be characteristic of a pneumococcus infection: the wide-spread œdema both above and below the seat of the bone lesion, which he has observed only in these cases.

Lexer, with other observers, calls attention to the fact that the pus in streptococcus infection is thinner (semipurulent), and that the necrosis of the bone, synovial membrane and soft parts is less, and that the medulla is usually not involved so rapidly nor to such a great extent as in the staphylococcus infection. This infection is usually most virulent locally; the staphylococcus next, and the pneumococcus least. Lexer called attention to the fact that the streptococcus may cause a non-purulent, serous effusion; that Ganey has produced this in animals, and that the so-called periostitis albuminosa is secondary to a streptococcus-osteomyelitis of a less virulent type, and that the albuminous exudate may be due to the degeneration of a purulent exudate.

As proof that the streptococcus in some instances may produce a very chronic osteomyelitis, Lexer mentions Kocher's very rare and interesting observation. Kocher excised an exostosis situated on the posterior surface of the external condyle of the femur. The patient was a boy, aged thirteen years, and the tumor had been noticed six months. The tumor consisted of a thin shell of cortical (apparently) bone mass, thick, and a centre of soft medullary tissue resembling granulation tissue. Cultures were not taken. The wound suppurated on the third day, and the streptococcus was found in the pus. On these grounds Kocher considered the exostosis to be due to a chronic streptococcus osteomyelitis.

In the earlier discussion of streptococcus osteomyelitis nothing was said of the appearance of the medulla of the bone. Lexer, in three cases of the first group, was able to study the medulla, both at the operation and at the autopsy.

Klemm<sup>1</sup> concludes as to the difference between streptococcus or pneumococcus and staphylococcus osteomyelitis cases as follows: 1. There is very little difference in onset and clinical signs. 2. In the two former infections one usually finds a definite etiological portal of entrance or primary focus of infection, as an infected streptococcus wound, pneumonia, otitis media, a pharyngitis of some kind, infected navel, etc. 3. The streptococcus and pneumococcus osteomyelitis are more common in young children. 4. In these two infections a wide-spread phlegmon of the medulla is rare; the focus is usually in or near the epiphyseal line, or in the cortical bone. The changes in the bone are slight; separation of the epiphysis is common, as is involvement of the joint. 5. In strepto-

<sup>1</sup> Sammlung klinische Vorträge, N. F., Leipzig, 1899, No. 234.

coccus infection the œdema of the soft parts is wide-spread—a condition common to streptococcus infections of all tissue. (Welch has called attention to the streptococcus as the cause of rapid œdema of the lungs, and Perutz speaks of the œdema with osteomyelitis as more common in the pneumococcus infection.) 6. Suppuration is less marked in the two infections than in the staphylococcus, but the tendency to gangrene (explained, perhaps, by the œdema) is greater.

The three cases in Lexer's first group, in which the osteomyelitis resembled the form usually supposed to be more characteristic of a staphylococcus infection, are of much interest. In each case the streptococcus was found in pure culture.

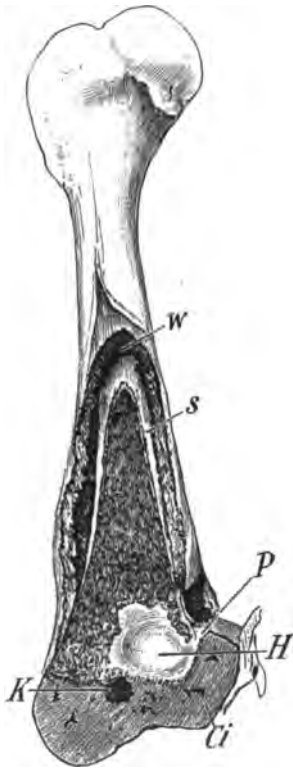
*Case I.* Healthy female, one year of age. In this patient, forty-eight hours after an injury to the knee, the child was feverish and showed evidences of suffering from pain about the knee. The child came under observation twenty-four hours later. There was an area of œdema over the internal condyle, and palpation was very painful. The general health of the child appeared excellent, and no sign of a portal of entrance for the infection could be found. An incision was made at once over the area of œdema. The periosteum over the internal condyle was yellowish and thickened; there was subperiosteal serous fluid. A small irregular opening was found at the juncture of the condyle and the shaft of the femur. On enlarging this opening the cancellous bone was seen to be widely infiltrated. The wound was left open and packed with gauze. There was but a scanty discharge from the wound, and the surface of the exposed tissue had that dry appearance so characteristic of very virulent streptococcus infection, seen especially in those cases in which the general infection is very grave. Streptococci were found in the blood on the fifth day, and death took place on the tenth day.

*Autopsy.* In addition to the small cavity at the epiphysis, found at the operation, the entire medulla of the femur was diffusely infiltrated and presented a grayish appearance, with small granular masses, and here and there small areas of hemorrhage. The periosteum of the entire shaft was thickened, but there was no exudate. No areas of infection were found in the other bones or organs. The picture was one of a localized osteomyelitis beginning in a small area of the epiphysis. In less than forty-eight hours a small perforation of the cortical bone was produced, with beginning subperiosteal abscess. The joint was not involved, but there was a secondary osteomyelitis of the entire medulla. This case demonstrated the wide-spread phlegmon that may take place in streptococcus osteomyelitis.

*Case II.* Female, aged one year. Vaccination was followed in (arm) forty six days by a large pustule and severe cellulitis, and an abscess in the axilla, which was incised. The wounds of this infection healed, and the

child was well for three weeks. The patient then became ill suddenly with fever and pain and swelling over the lower epiphysis of the tibia; operation was performed within forty-eight hours. The tissue was œdematous; the periosteum was thickened and the subperiosteal effusion was persistent; the cortical bone showed no marked change. The medulla in the region of the epiphysis was uniformly infiltrated, greenish in color, with yellow dots; later the entire shaft of the ulnar became necrotic and separated, the entire medullary cavity becoming

FIG. 23.



Streptococcus osteomyelitis, right femur, child nine weeks old. (LEXER.)

involved, and on the third day pus was found in the elbow-joint; an epiphysitis of the lower end of the radius, with the formation of a small sequestra, and on the sixth day an epiphysitis of the lower end of the humerus without separation were found. The child made a good recovery, with good function of the arm and joints, although streptococci were found in the blood on the third day.

*Case III.* Child, nine weeks old, poorly nourished. Three weeks before admission a painful swelling was found below the knee, which ruptured on the inner side. On examination the child was not feverish; the lower third of the thigh was swollen; there was no fluid in the knee-joint. At operation the fistula was found to lead to a cloaca in the posterior surface of the epiphyseal line, and the medulla showed a purulent infiltration. The child died in a week. Vomiting and diarrhœa were present, but no fever.

*Autopsy.* Fig. 23<sup>1</sup> gives an excellent idea of the pathological anatomy of the right femur. *P*, perforation; *H*, focus of sup-puration; *S*, beginning necrosis of the shaft; *W*, periosteal new bone formation tissue; *Ci*, internal condyle; *K*, centre of ossification. The lower half of the femur was thickened, due to new vascular periosteal bone, 4 mm. in thickness; in places the new bone was separated from the beginning necrotic shaft by cheesy granulation tissue, but no purulent exudate. The cortical bone of the old shaft was yellowish-white; the new periosteal was dark red; the medulla was a diffuse grayish-yellow,

<sup>1</sup> Archiv für klinische Chirurgie, Band lvii.

with areas of hemorrhage. The lower two-thirds of the cancellous bone of the shaft above the epiphyseal line and somewhat below was destroyed and replaced by a dirty, slimy mass of necrotic tissue. There was beginning separation of the epiphysis.

These three cases just described demonstrate that wide-spread phlegmon of the medulla, and sequestration, can be produced by the streptococcus. The wide-spread œdema of the soft parts spoken of by Klemm as characteristic of the streptococcus infection was not observed by Lexer.

The second group of cases, all infants three weeks to two years of age, demonstrated that the disease usually described as acute arthritis of infants is, with few exceptions, secondary to an osteomyelitis at the epiphysis. Acute arthritis of infants was first described by Volkman. On account of the peculiar slimy synovial exudate he called it catarrhal synovitis, and also called attention to the early ruptures of the capsule and to the formation of extracapsular abscess. Krause demonstrated that the infectious agent in Volkman's acute arthritis of infants was the streptococcus, and Lannelongue first called attention to the fact that most of these cases were due to a primary bone focus at the epiphysis. Later, in this country, Townsend, Arsdale and Koplik<sup>1</sup> confirmed Lannelongue's observation that the streptococcus arthritis of infants was secondary to an osteomyelitis.

The seven cases described in this second group had the characteristic anatomical picture of acute osteomyelitis at the epiphysis (called by English surgeons epiphysitis). Each case showed a small suppurating focus on the diaphyseal side of the epiphysis, a rapid involvement of the joint, in many cases by a direct communication through a minute perforation, and in many cases subperiosteal and extracapsular abscesses. In no case was there extensive infiltration of the medulla nor the formation of any (except in a few cases) minute sequestra. Extensive œdema (spoken of by Klemm) was not noted. In six cases there was but one focus: lower femur, 2; upper humerus, 2; lower humerus, 1; lower tibia, 1. In one case there were two foci: lower radius and upper femur. Two very young children, who before the onset of the disease were weak, died: one of bronchopneumonia and the other of multiple lesions. One of the five healthy children died of pneumonia. The functional result of the five cases which recovered was perfect.

The six cases in the third group all recovered after incision (five cases) or aspiration (one case) of the affected joint, so that it was not possible to demonstrate nor exclude a primary infection in the neighboring epiphysis. In one case an X-ray photograph showed that there had been a separation of the epiphysis, which had not been recognized when

<sup>1</sup> American Journal of the Medical Sciences, 1892.

the extra-articular abscess of the hip had been incised. At this operation an opening into the joint capsule had been observed. The infection was checked by simple incision. Two years later there was limitation of motion and 2 cm. shortening. The infection, which was due to the streptococcus and had followed pneumonia in a child ten months old, ran a rather chronic course during the two weeks before the operation. In a second case, a rhachitic boy, eighteen months old, the arthritis followed an attack of bronchitis. The seropurulent effusion in the right knee had been present two weeks, but recovery, with perfect function, followed simple aspiration, although streptococci were present in the fluid. The remaining five cases were healthy children. A point of entry for the infection could not be demonstrated. All recovered rapidly, with unimpaired function of the joint after simple incision.

1. Girl, aged eight months; elbow; streptococcus.
2. Boy, aged nine months; shoulder; onset, two days; suppuration both in joint and extracapsular tissue. Culture, cover-slip, and animal inoculation demonstrated the pneumococcus of Fraenkel and Weichselbaum.
3. Boy, aged three and a quarter years; elbow; onset, acute, three days; streptococcus.
4. Female, aged two years; knee; onset, few days; both intracapsular and extracapsular suppuration; streptococcus.

**Pneumococcus Osteomyelitis.** Perutz<sup>1</sup> reports one case of pneumococcus osteomyelitis in a boy, aged eleven months. The infection began in the upper epiphysis of the humerus, and the first local symptom was noted thirty days after the onset of the pneumonia. Perutz states that Ullmann, in 1891, was the first to demonstrate the presence of the pneumococcus in the cases of osteomyelitis following pneumonia, although Hausen, in 1877, and Leyden, in 1885, each reported a case of osteomyelitis following pneumonia. In Hausen's case the osteomyelitis had produced a suppuration and partial destruction of the head of the humerus. Pus was found in the neighboring shoulder-joint and an extracapsular abscess had formed. The patient was a male, aged fifty-three years. In Leyden's cases the patient (age not given) died. A diplococcus was found on the cover-slip from the pus in the knee. Cultures were not made. In this case if an osteomyelitis was the primary cause of the arthritis it was not well marked. Ullmann's case was a male, aged thirty-four years. After an attack of pneumonia an extracapsular abscess formed over the upper epiphysis of the humerus. Cultures and cover-slips from the abscess when it was incised demonstrated the pneumococcus. Later a sequestrum formed and was removed.

Witzel, in 1890, called attention to acute infectious osteomyelitis following various infections of the lungs. K. Miller, in 1893, considered

<sup>1</sup> Münchener med. Wochenschrift, January 18, 1898, Jarg. xlv. p. 81.



the pneumococcus infection of bones to be more of a periostitis and ostitis—similar to Lannelongue's view of streptococcus infection—but in both infections there are now many observations which demonstrate that a true osteomyelitis beginning in the medula is not uncommon.

A summary of these and other cases reported by Perutz, Fischer and Levy, Lannelongue and Archard, Lexer, and Blecher, in all of which the pneumococcus of Fränkel and Weichselbaum was found in pure culture, brings out many points of interest: Eight patients were children; 4 cases less than one year of age; 3 cases under two and a half years; 1 twelve years. Two men, adults, aged fifty-three and thirty-four years; one not stated. Etiology: Pneumonia, 5 cases; otitis media, 2 cases; not stated, 4 cases; 2 cases died from the pneumonia; the others recovered, with good use of the joint. Separation of the epiphysis was noted in 5 cases: 2 at the shoulder and 1 at the hip and 1 at the knee. In the two shoulder cases the head of the humerus was removed; in one of these the diaphysis was slightly involved. The anatomical picture in these cases corresponds to the case discussed by Lexer in his second group of streptococcus osteomyelitis with marked arthritis. The focus of suppuration is usually small and single; perforation, with involvement of the joint and formation of the subperiosteal and extracapsular abscesses, occurs early. The prognosis of pneumococci infection appears to be the best.

One case reported by Lannelongue and Archard is of great interest, because at autopsy only a periostitis of the femoral neck was found; also an arthritis of the hip, with rupture and a separation of the epiphysis, but no foci in the femur. I find in the *Lancet*, September, 1898, vol. ii., a similar case. The note of the case was furnished by Dr. Stuart McDonald. The patient, a boy, aged fifteen years, six months before the acute onset was kicked in the left hip at a foot-ball game. He felt very little discomfort at that time. He was admitted seven days after the onset, which was characterized by intense pain in the left groin, and a limp. On admission he was very ill, and had the usual appearance of a marked general infection. A small abscess which was situated "over and above" the great trochanter was opened. Death took place in twenty-four hours. At the autopsy pus was found in the hip-joint, and the periosteum of the femoral neck was thickened and separated by an exudate of pus. No foci of pus or infection were found in the femur. Cover-slips from the pus showed micrococci, diplococci, and staphylococci. Cultures were not made. In both of these cases the primary lesion may have been in the hip-joint.

**Acute Osteomyelitis in Infants.** Hertzog and Krautwig<sup>1</sup> report a case in a child of seventeen months, which is of especial interest, because

<sup>1</sup> Münchener med. Wochenschrift, 1898, Jahr. i., 45m.

of the multiple lesions and the complete anatomical picture given by the autopsy. The authors also discuss many interesting points in the etiology and pathology of osteomyelitis, and bring out the fact of its quite common occurrence in infants. Their patient was admitted after an illness of fourteen days, and on admission a diagnosis was made of arthritis of the shoulder, bronchitis, and left lobar pneumonia. At the operation, which was performed at once, there was found a purulent arthritis of the shoulder-joint, with an extracapsular abscess and a partial separation of the epiphysis of the humerus. Inoculation showed staphylococcus pyogenes aureus in pure culture. At the autopsy, on the fifth day after operation, purulent epiphysitis with separation was found at the sternal ends of a number of ribs and in the upper epiphysis of one femur. These lesions were not recognized by any local signs before death. There was also found a healed diphtheritic inflammation of the nasopharynx and desquamation of the skin, the latter pointing to scarlet fever as the primary cause, and the pharyngitis as the cause of the pyæmic foci in the bone, which were demonstrated to be due to the aureus.

These authors refer to the report of Braquehaie, in 1887, of 162 cases of osteomyelitis in children under two and a half years of age; in the majority of these patients the disease began with the first year of life. In many the bone suppuration was not recognized, as death frequently took place before any local symptoms manifested themselves. In Hertzog and Krautwig's case it has already been noted that the foci in the ribs and the upper end of one femur were not recognized until autopsy.

**Osteomyelitis of the Pubic Bones.** A. Kirschner<sup>1</sup> reports a unique case with separation of the medial epiphyses of the pubic bones. In looking over the German literature, Kirschner was not able to find reference to any similar case. However, he found a few in recent French literature. I have also found one case in recent literature not referred to by Kirschner.<sup>2</sup> Kirschner's patient was a cavalry soldier, twenty-one years of age. Seven days after an infected wound in the region of the knee the symptoms of trouble in the pelvis began. The local symptoms were not at all marked. There were pain, tenderness, and, later, induration in the lower abdominal zone, somewhat similar to an infection of the space of Retzius after rupture of the bladder. There were, however, no external signs of infection, although the general symptoms were very acute and marked. At the operation suppuration was found in the tissues in the space of Retzius. Both pubic bones were separated from their medial cartilage ends and from the cartilages at the symphysis. The periosteum of the pubic bones was partly separated by suppuration, and there was some necrosis of the bone. The cartilage ends, however,

<sup>1</sup> Archiv für klinische Chirurgie, 1899, Band lviii., Heft 2.

<sup>2</sup> Gazette des Hôpitaux, Paris, 1898, lxxi.

showed very little change. The patient made a good recovery, and there was firm union at the symphysis. In connection with this very unique case, Kirschner discusses the epiphyses of the pelvic bones and the rarity of osteomyelitis of these bones, especially at the medial ends of the pubic bones. With regard to the epiphyses of the pelvic bones, Merkel informed him by letter that in an edition about to be published of Merkel and Henle's *Grundriss die Anatomie* the epiphyses of the pelvic bones are noted in the following places: (1) Along the whole upper edge of the ilium; (2) anterior surface of the iliac spine; (3) tuberosity of the ischium; (4) symphyseal ends of the pubic bones, and (5) the tubercle of the pubic bone. Ossification in numbers 3, 4, and 5 takes place between the fifteenth and sixteenth years; in all between the twenty-second and twenty-fifth years. I find a similar statement in Quain's *Anatomy*, edition of 1890. Kirschner thinks that in his case the primary focus may have been in the tubercle of the pubic bone on one side and perhaps the medial epiphyseal end of the other side.

Osteomyelitis of pelvic bones is without doubt very unique. Well-known German authors, like Ullmann, Schede, Kocher, Luke, and Volkman, have each recorded a few cases situated in the iliac bone; none at the symphysis. The French, however, have contributed most to this form of osteomyelitis. Guillard states that before puberty the centre of the cotyloid cavity is the usual focus and after puberty the iliac crest. Laurent Prefontaine has recorded a case similar to Kirschner's in a patient aged fifteen years. I have operated in Halsted's clinic on a case of osteomyelitis of the tuberosity of the ischium in a boy ten years of age, and have observed three cases in adults of osteomyelitis of the iliac crest. Bruns and Hansel,<sup>1</sup> in a recent article on "Osteomyelitis in the Upper End of the Femur," record cases of primary osteomyelitis of the cotyloid cavity, and also secondary foci in this cavity and in the pelvic bones associated with the foci in the upper end of the femur.

The subject of osteomyelitis of the pelvic bones is a very interesting one, especially with regard to the situation of the primary focus and the early symptoms, which are often very obscure, and the direction of the burrowing in the bones in neglected cases. One wishing to become familiar with the details of this subject should refer to the original articles mentioned by Kirschner, which are chiefly in the French journals. Judging from the cases reported by Bruns and Hansel, in which pelvic osteomyelitis complicated osteomyelitis of the upper end of the femur, the prognosis is very grave in these cases.

**Osteomyelitis with Softening and Bending of the Bones.** Fractures both in acute osteomyelitis (due to wide-spread necrosis) and in

<sup>1</sup> Beiträge zur klinische Chirurgie, Band xxiv., Heft 1.

chronic osteomyelitis (due to the brittleness of the new bone) are not uncommon. Bending, however, is rare, and Birch-Hirschfeld<sup>1</sup> reports such a case under the title of "A Rare Case of Acute Osteomyelitis." The patient, a boy, aged ten years, was admitted to the Leipsic clinic three and a half months after the onset of the disease. It began with the usual general symptoms of an infection, but locally the disease had run a very subacute course. When examined the lower third of the femur was thickened by a spindle-shaped swelling (not unlike new growth). The bone at a position about a hand-breadth above the knee-joint was bent at a right angle, convexity posteriorly. However, an X-ray photograph which showed a sequestrum below the bending confirmed the diagnosis of osteomyelitis. At the operation there were no cloaca; the sequestrum was removed. The soft granulation tissue in the medullary cavity showed no gross evidence of suppuration, but cultures and cover-slips demonstrated the staphylococcus pyogenes aureus.

The writer tells us that Obersteiner has observed a similar case in a girl, twelve years of age; Mosetig, three cases. In these four cases the bending of the bone was situated in the lower third of the femur, which is rather an uncommon position. Other observers—Volkman, Schede, Deisternag, Küster—have reported a number of cases of bending of the bone at the upper end of the femur, due to osteomyelitis. Von Recklinghausen describes this softening as due to an ostitis fibrosis; muscle-pull and body-weight are the direct causes.

**Recent Views on Etiology and Pathology of Osteomyelitis.** Hertzog and Krautwig, in an article which I have just referred to, give an interesting résumé of the views held by different authors. Krasky believes that osteomyelitis can cause or be caused by pyæmia; Jordan, that acute osteomyelitis is identical with the bacterial form of pyæmia, but that the transition between pyæmia and osteomyelitis is often very difficult to differentiate.

Pyæmia has usually multiple foci. In osteomyelitis the foci are always in the bone, and frequently there is but one. Both conditions are preceded by a bacterial septicæmia.

Kocher believes that pyæmia should be used in a broader sense, as a term, than osteomyelitis, and suggests the following nomenclature: For pyæmia, staphylomycosis multiplex and metastatica; for septicæmia, staphylohæmia, and for osteomyelitis, staphylomycosis circumscripta acuta and chronica. These terms clearly explain themselves and picture the condition better than the older terms. As to the etiology of osteomyelitis, it has been clearly established by clinical, pathological, and bacteriological proof that osteomyelitis can be produced by various forms

<sup>1</sup> Centralblatt für Chirurgie, 1898, No. 42; original, Deutsche Zeitschrift für Chirurgie, 1898, Band xlv.

of bacteria, the staphylococcus pyogenes aureus being the most common agent; but more frequent and more careful bacteriological investigations are demonstrating that the streptococcus, pneumococcus, and typhoid infections especially, are not rare. It is interesting to note that in the great majority of cases the infection is pure; mixed infection is rare.

The portal of entrance of the infection frequently cannot be demonstrated, sometimes because of its locality, at other times because the very slight local change produced by the infective agent is not sufficient to attract the attention of the patient or the surgeon; also, in perhaps the majority of cases, because the observers are not competent.

Krause believes that the tonsils are the portal of entrance in many cases, and autopsies have confirmed this view. I have seen two cases of general peritonitis with no demonstrable cause for infection except a bacterial pyæmia from a streptococcus tonsillitis. Bascheke and Lexer report a case of streptococcus osteomyelitis in which at autopsy an abscess was found in the tonsil. Kocher believes that the staphylococcus never develops early in inflammations of the mucous membrane, but is a late invader. But when it has once joined in the mixed infection at the portal of entrance it is the most common to produce the bacterial pyæmia and the metastatic foci of suppuration. This was considered to be true in Hertzog and Krautwig's case. The child had scarlet fever and a streptococcus diphtheritis, but the metastatic foci in the bones which developed later were due to the staphylococcus pyogenes aureus. It is also the rule, especially in osteomyelitis secondary to some primary infection, that the metastatic foci of suppuration develop late.

Senn has called attention to the infection of the new-born child through the placenta when the mother is septic. Kormann and Guillard have demonstrated that the cause of arthritis and osteomyelitis in nursing children is due to the infected mother's milk. The infected navel and infection following vaccination are frequently the cause of a bacterial pyæmia followed by metastatic foci, especially in bones.

**HISTOLOGICAL RESEARCH IN EXPERIMENTALLY-PRODUCED ACUTE OSTEOMYELITIS.** One interested in this very interesting pathological study should read the recent and excellent article of Enduler<sup>1</sup> from the Pathological Laboratory in Marburg.

**Squamous Epithelioma and Epithelial Hyperplasia in Sinuses and Bone following Osteomyelitis.** At every operation for chronic osteomyelitis in which there have been a sinus and a bone cavity present for a number of months, it is important for the surgeon to bear in mind the possibility of the invasion of the sinus and bone cavity by epithelial cells and the formation of a malignant epithelioma. S. M. Cone<sup>2</sup> reports

<sup>1</sup> Deutsche Zeitschrift für Chirurgie, 1899, Band lvii., Heft 3 and 4.

<sup>2</sup> Johns Hopkins Hospital Bulletin, 1897, vol. viii.

one case of epithelioma and one case of epithelial hyperplasia. In addition to the complete report of these two cases there is an excellent macroscopic and microscopic description, and a complete bibliography of the most important literature. Cone tells us that there are but twenty-eight cases of typical squamous epithelioma in sinuses and bone cavities following osteomyelitis. (Refer to Cone's article for a brief résumé of these cases.)

I operated on a colored man, aged forty-five years, the first case reported by Cone, in Professor Halsted's clinic. The acute attack of osteomyelitis of the left tibia took place nineteen years before, since which time there had been sinuses and discharge of sequestra. One month before entering the hospital the patient began to feel pain in the leg, and there was a distinct increase in the amount and odor of the discharge. When I examined the patient before operation there was nothing externally to suggest anything different from the ordinary chronic osteomyelitis with sinuses. However, at the operation, when I began to chisel the tibia the medullary cavity, with which the sinuses communicated, contained, instead of the granular tissue or sequestra, soft tissue, in which one saw many little yellow dots, which could be expressed on pressure. Macroscopically it was that typical picture that one sees in carcinoma and epithelioma, the yellow areas being due to the necrotic epithelial cells in the centre of large alveoli. This diseased tissue was found to extend up to the upper epiphysis of the tibia and downward to the middle of the shaft. In addition to this typical tumor formation one found beneath the periosteum a slight formation of new bone, and it was also interesting to note—which one does not see in osteomyelitis—that scattered throughout the tumor tissue in the medullary cavity there were small spicules of new bone. Dr. Cone examined the tissue microscopically and reported a typical squamous epithelioma. With these indications the leg was amputated above the knee, and the patient is to-day (June, 1899, one year and six months since the operation) well without recurrence.

The second case is one of epithelial hyperplasia in an old bone sinus. I also observed and operated on this patient. He was white, male, aged fifty-four years. Forty-nine years before (five years of age) the patient had an acute osteomyelitis of the lower end of the femur, since which time there had been a discharging sinus. On examination one found a sinus leading into a large bone cavity in the lower third of the femur; the shaft of the lower half of the femur was considerably enlarged. On account of the patient's age and the large size of the cavity and the eburnation of the involucrum, I advised the patient to have the leg amputated. The leg was painful, the knee was almost completely ankylosed, and the limb was practically useless. I felt, on account of the

eburnation of the bone, that it never could be filled with granulation tissue or new bone. Dr. Cone made a microscopical examination, and found that the entire bone cavity was lined by squamous epithelial cells. Here and there were places where these cells took slightly atypical growth, but at no area was there any evidence of typical squamous epithelioma. I have alluded to this article not only because it is the best in the recent literature, but to impress upon surgeons always to bear in mind the possibility of carcinoma not only in old ulcers and sinuses, but in those communicating with chronic osteomyelitic bone cavities. I

FIG. 24.



X-ray. Total resection of right femur for osteomyelitis, five months after operation.

believe that in almost every case, if one studies carefully at the operation the gross appearances of the tissue filling the medullary cavity, a diagnosis can be made. In the first case if I had had permission to amputate I should have done so at the first operation, owing to the gross appearance.

**Total Resection of the Diaphysis of Long, Hollow Bones for Acute Osteomyelitis.** Jottkowitz<sup>1</sup> reports one case, with an X-ray photograph of the patient five months after operation. (See Fig. 24.) This picture

<sup>1</sup> Deutsche Zeitschrift für Chirurgie, June, 1899, Band lii., Heft 1 and 2.

shows the new-bone formation. Fig. 25 shows the patient two and a half years after operation. During this time the shortening had increased only 1 cm. (from 3.5 cm. to 4.5 cm.).

FIG. 25.



Same patient (Fig. 24), two and one-half years after operation.

The patient was three years old. On admission, about one month after the onset of the disease, the right thigh was swollen from groin to knee, and there was a fistula in the groin. The right shoulder was swollen. At the first operation a small localized focus was removed from the shaft of the humerus just below the epiphysis. The abscess about the femur was inside. The hip-joint was involved and the upper epiphysis was separated. In a short time it was necessary to operate again, when the head and upper part of the shaft of the femur were removed; it was then found necessary to operate a third time, and at this operation the entire shaft of the femur was removed almost to the lower epiphysis. Not until this was done did the symptoms of local and general infection disappear. The wound healed rapidly, and the formation of new bone at the end of five months was well shown in the X-ray photograph.

In the discussion of the literature Jotchkowitz finds that English and French surgeons have advocated this treatment in certain cases, but that German surgeons have been averse to the radical procedure—first, because of the danger to life from hemorrhage; second, because of the faulty regeneration of the bone leading to a great deformity and shortening.

Jotchkowitz believes that if the subperiosteal removal of the diseased shaft is performed early, before the involucrum is excessive, the danger from hemorrhage is slight and the separation is easily accomplished. Properly treated, the danger of marked deformity and great shortening is not great. Without doubt, he was successful in his own case.

Personally, I believe that a total resection of the diaphysis is seldom indicated, even when it can be accomplished early and without increased risk of death. When the entire medulla is infected and necrosis of the shaft is present, to chisel a wide longitudinal section from epiphysis to epiphysis, leaving from one-half to two-thirds of the shaft with chiselled windows here and there, will accomplish almost as perfect drainage as the complete removal of the shaft itself. This method is unques-



tionably less extensive, and there is less danger from hemorrhage. The remaining shaft is able to act for some time as a support, while the involucrum is being formed. I have observed a number of such cases, with excellent results.

**The Importance of an Early Diagnosis and Operation in Acute Osteomyelitis.** I have considered somewhat in detail the recent literature of osteomyelitis, because of its great practical importance. The disease is common. The majority of our cases come to the hospital emaciated, with prolonged infection and with pathetic local conditions. The usual history is as follows: With or without a previous attack of some infection the patient is taken suddenly with fever, sooner or later with pain, and then swelling about one or more joints. Rheumatism is diagnosed. The affected joint is covered with a flaxseed poultice. After a prolonged siege of pain and fever the bone abscess shows itself beneath the skin; it is then allowed to rupture or a superficial incision is made. When the patient comes to the hospital one finds one or more fistulæ, the involucrum is excessive, and there is usually a myositis, with contraction. The joint may be completely ankylosed from secondary arthritis. The most happy result from operative surgery in these cases can never be compared to the results of early operation.

We should always bear in mind that not only in children but in adults osteomyelitis may give rise to marked general symptoms without very marked local signs, so that the clinician should frequently examine bones and joints of the body. The first local sign of an osteomyelitis at the epiphysis is referred to the joint. The symptoms of arthritis frequently predominate over those of the osteomyelitis. We should always bear in mind that primary arthritis is much less common than the infection secondary to an osteomyelitis.

Given a swollen joint, with or without the history of traumatism, the effusion should be aspirated at once. If one finds the gonococcus in cover-slips or cultures this practically excludes osteomyelitis. In simple traumatic synovitis the effusion is rarely purulent; the aspirated cultures are sterile; there is seldom fever. In one case, in a boy, ten years of age, forty-eight hours after an injury associated with a temperature of  $103^{\circ}$ , I found the effusion in the knee-joint very cloudy with leucocytes. The cultures, however, were sterile. The general and local symptoms disappeared at once after the aspiration. In the second case, in a boy, seventeen years of age, twenty-four hours after a contusion of the knee, he was taken with high fever and rapid swelling of the knee-joint. Admitted to the hospital on the third day, with a temperature of  $104^{\circ}$ , we found in the aspirated cloudy fluid numerous streptococci. Recovery, with perfect function, followed arthrotomy and irrigation. We have a like observation in which the staphylococcus pyogenes aureus was found.

Purulent arthritis following contusion is very rare, except when secondary to an osteomyelitis. Streptococcus and pneumococcus arthritis, metastatic from primary infection, is usually associated with or secondary to the metastatic osteomyelitis. In view of these observations, when we are dealing with infection of or about a joint (except the gonococcus) we should always bear in mind the great probability of a primary bone focus.

Incision and curetting of the bone in the early stages of acute osteomyelitis is followed by the most happy results. If the neighboring joint is distended with fluid it should be aspirated. If the effusion is purulent and contains bacteria, arthrotomy and irrigation should be performed at once. The results of such early treatment in infected joints are, in the majority of cases, as excellent as upon the bone focus itself.

Rarely cerebro-spinal meningitis shows itself first by joint symptoms. Aspirating such a joint and finding the characteristic micro-organism would be a point in diagnosis.

### **BENIGN AND MALIGNANT TUMORS OF BONE.**

It is of the utmost importance for the surgeon to bear in mind the existence of the benign forms of tumor of bone. In the malignant sarcoma experience has demonstrated that the most radical operation is necessary to prevent recurrence: amputation of the thigh in sarcoma of the bones of the leg, or of the arm in sarcoma of the bones of the forearm, and for sarcoma of the thigh, amputation at the hip-joint, and for sarcoma of the humerus, disarticulation above the shoulder-joint. When these high amputations are performed local recurrence is very rare, although in many cases death follows from internal metastasis. It has been demonstrated, therefore, that the high amputation will cure cases of malignant sarcoma of bone, provided metastasis has not taken place before the operation is performed. There is, however, a second but much smaller group of tumors, in which it is not necessary to amputate. An excision with the chisel or removal with the curette will not only completely remove the tumor, with little chance of recurrence, but at the same time save the limb.

In view of these two forms of tumor, in which the operations for cure are most radically different, surgeons should school themselves in the differential diagnosis by clinical history, by the examination of the tumor itself, and perhaps most important by the gross appearance of the tissues exposed at the time of operation. The number of tumors belonging to the malignant group is usually large even in the experience of one clinic, but the benign forms of tumor of bone are rare. And most of us, if we wish to be prepared to make pathological diagnoses

at once when we first meet such a case, must carefully read the description of such tumors by those surgeons who have had the good fortune to meet them.

König<sup>1</sup> some years ago called attention to certain forms of benign giant-celled sarcoma, with origin and situation in the medulla of the long bones, which he had cured by curetting. These cases, however, are rare in the experience of most surgeons; but there are sufficient cases collected to demonstrate that these tumors first described by König are benign. F. König<sup>2</sup> calls attention to the solitary cysts of long bones, and to cystic enchondfibromata, which are probably more benign than the giant-celled sarcoma just referred to. König's cases are from the clinic of von Bergmann, in Berlin. He first makes a few remarks in regard to the ultimate results after operation for the malignant sarcomata. Previous to 1889, Nasset collected from von Bergmann's clinic 25 cases of malignant sarcoma, in all of which the most radical and highest amputation had been performed. Seven of these cases are now living and 18 are dead. Since then König has collected 16 cases, 4 of which are living and 12 dead; of these 12 died in the first year; so that of 41 cases of amputation from malignant sarcoma 30 have died. He does not state how many had local recurrence. One would infer that the majority of them died from metastases and not from local recurrence. He does not include in this group the more benign form of giant-celled sarcoma.

F. König's description of the clinical history and pathological appearances of simple bone cysts is very characteristic. These cysts originate in the shaft of the long bones near the epiphyseal line, and without doubt from islands of cartilage, which will be discussed later. The cysts are simple or multiple, usually single. As they enlarge they expand the cortical layer of bone. This pressure produces atrophy, and the thin layer of bone over the cyst soon becomes soft and compressible in places. The contents of the cyst is a cloudy or bloody serous fluid, and frequently the wall beneath the cortical bone is made up of a small amount of tissue which differs from the type of tissue about it. Now and then there are no remains of this tissue.

The clinical picture is somewhat characteristic. The cysts occur in young people at or before puberty, and the first symptom complained of is pain, which is intermittent; soon there is lameness, but on examination one does not feel any particular change in the part of the bone which is the seat of pain. The leg may in time be shorter. Two years may pass, and then from slight trauma the patient is admitted to the hospital with a fracture, or he may complain of slight bending

<sup>1</sup> *System of Surgery*, 1894.

<sup>2</sup> *Archiv für klinische Chirurgie*, 1898, Band lvi., Heft 3.

of the bone and great tenderness, and on examination in either case one finds a slight enlargement of the bone, but most characteristic are the soft areas, which, with the examining finger, are found to be compressible. If an incision be made the tissues are found to be normal; the periosteum is unchanged. Beneath this we find a thin layer of cortical bone, which when removed exposes a cyst with yellow or bloody serous fluid, and a wall which consists of brownish tissue or a tissue of a slightly bluish color, like hyaline cartilage. One may see here and there the remains of septi, and it will be found that the cyst extends to the epiphyseal line, the latter being normal. Such is the clinical and pathological picture of a simple bone cyst, which should be easily differentiated from a malignant sarcoma.

König discusses in detail the origin of these simple bone cysts, and refers to Virchow's investigation, which demonstrated the remains of embryological cartilage or misplaced cartilage from the epiphyses; these

FIG. 26.



a. Epiphyseal line.  
b. Island of cartilage.

islands being isolated from the cartilage of the epiphyses are situated in the medulla of the shaft at some distance from the epiphyseal line. According to Virchow, the islands of cartilage can give rise to the enchondroma of the shaft of the long bones. If the cartilage is misplaced outward we get the cartilaginous exostosis at the epiphysis. Virchow considered that the simple bone cysts were liquefaction necroses of the solid cartilage tumors, and he was able to demonstrate in the wall of these simple bone cysts small islands of cartilage (Fig. 26). Zeronie has confirmed Virchow's observations, and later Schlange was able to demonstrate this cartilage in the wall of

the bone cyst. König, in his case, found small islands of cartilage in the cyst-wall.

The second benign tumor which König describes is a cystic enchondroma of the long bones. The clinical history, and especially the pathological appearance, of these very complex tumors is, I believe, more difficult to differentiate from a malignant sarcoma. König's description is excellent, and I feel certain that he has described a tumor which I also have seen and considered to be benign. König's patient was a girl, fifteen years of age. During the last two years she had complained somewhat of pain in the right thigh, and now and then had walked a little lame. For the last year she had noticed that the right hip has been somewhat prominent. One week before admission, after a very slight

trauma directly over the right hip, a swelling formed, and the patient could not walk. On admission to the dispensary dislocation was thought to be present and an attempt at reduction was made, without result. The patient was then sent to the clinic. It was found that the right leg was 2 mm. shorter than its fellow, and that swelling and great tenderness began at a point above the great trochanter and extended down to the junction of the middle and lower third of the femur. There were crepitus and mobility situated below the trochanter. A diagnosis of fracture was made, and the patient was treated for this. At the end of eight weeks union of the bones seemed to be solid. On making an examination at this time there was noted a uniform swelling of the shaft of the bone, beginning with the trochanter and extending to the middle third. The hip-joint was free. This swelling was irregular; there were definite nodules here and there, and one felt the characteristic soft areas compressible on palpation. In view of the slow growth (two years) and the soft areas with slight fluctuation, von Bergmann thought that the case, from a clinical stand-point, was one of a benign tumor. That the fracture healed König thinks did not exclude malignant sarcoma, as he states that it is well known that fractures at the seat of malignant tumor of long bones frequently heal. [I have never observed this in our cases of fracture.]

At the operation von Bergmann found a thin shell of cortical bone thrown out in irregular protuberances, and on removing this shell a tumor which consisted of many cysts, between which was solid tumor tissue. Some of the cysts resembled the simple bone cysts, in that the contents were brown or yellow, and that the wall appeared somewhat like hyaline cartilage. In the solid tumor tissue there were a good many areas of hemorrhage and mucoid necrosis. This cystic myxomatous tissue filled up the entire medulla of the shaft and extended even into the neck of the femur. It was entirely removed with the chisel and curette after fracturing the femur. The wound was packed with gauze. At the end of six weeks the wound had healed and the leg was solid. The patient left the hospital in good health, with no evidence of recurrence. König does not report any examination made since that time. The gross and microscopical description of this tumor is given in great detail, and should be consulted. König thinks he found (in the tumor) cysts resembling the simple bone cysts, in that their walls contained cartilage and that the fluid was due to the liquefaction. Many of the other cysts were due to necrosis of hemorrhagic areas, and many more to mucoid degeneration of cartilage cells. The tumor cells themselves were of a mixed variety, and there were many spindle cells and connective tissue cells of irregular form, many areas of hemorrhage, and many areas where the nuclei stained poorly, showing beginning degeneration of some kind; there were also giant cells which resembled osteoclasts, these cells being

arranged about the islands of cartilage. König states very correctly that one cannot always judge of the character of the tumor by the microscopical examination of a small part. In this tumor, if some of the solid tissue alone were examined, it would be considered, perhaps, to be a rather malignant sarcoma; but considering the tumor as a whole, the presence of the round and spindle cells is not necessarily indicative of a malignant sarcoma. Bone itself always contains very complex cells, and when there is any change going on in the bone the new tissue is also complex.

König thinks that these very complex cystic enchonfibromata can be explained very much like the more simple solitary cysts of long bones. The origin of the tumor, he thinks, is without doubt from the erratic islands of cartilage situated below the epiphyseal line—in this case below the trochanter—and the tumor was probably an enchondroma, which in its growth and increase of cells had formed a variety of the simple cysts, a cyst due to myxomatous degeneration and cysts due to degeneration of hemorrhagic areas; and he believes that the cellular part of the tumor, which was chiefly fibromatous, with here and there a spindle cell and now and then giant cells, is not necessarily indicative of a sarcomatous change.

**Resection Instead of Amputation for Malignant Sarcoma of the Long Bones.** Mikulicz<sup>1</sup> was the first to practice extensive resection of the long bones rather than amputation for malignant sarcoma. He seems to have first been led to this less radical procedure because in the early period of the disease the tumor occasioned so little discomfort to the patients; especially in Germany, these patients are very much averse to an amputation. It seems almost impossible to impress them with the malignancy of the disease when it is giving them so little local discomfort. With the experience of past cases surgeons are impressed that the later an operation is performed for sarcoma of bone the greater the danger of internal metastases; and even in many cases where the local symptoms have been present but a few months or even weeks, metastasis has already taken place. Mikulicz found that he could persuade these patients to consent to a resection of the bone when they would refuse an amputation, and thought that in early cases a resection was justifiable if amputation was refused. The results in his cases were so gratifying that he was led to advocate resection in all those cases of malignant sarcoma of bone where the disease could be completely excised without injury to the great vessels of the limb or without removal of so much tissue that the result left a useless leg. Weisinger,<sup>2</sup> in a short article entitled "The Treatment of Malignant Tumors of Long Bones,"

<sup>1</sup> Archiv für klinische Chirurgie, 1895, Band I. p. 661.

<sup>2</sup> Deutsche med. Wochenschrift, October 20, 1898.

refers to Mikulicz's former work, and reports some of his own cases of extensive resection of the long bones for malignant sarcoma. It is interesting to note, however, that Weisinger records a case of benign enchondroma situated in the medulla of the femur below the trochanter. The patient was fifty years of age, and the chief symptom had been sciatica. The tumor was removed by the chisel and the curette, because the operator considered it to be one of the benign forms of bone tumors, and although as far as the naked-eye appearances went the tumor seemed to be completely removed, local recurrence took place in three months. A second operation consisted of exarticulation of the limb at the hip. The patient lived six years without recurrence, and died of tuberculosis of the lungs. At the autopsy there were no metastases found.

Weisinger then goes into a discussion of how difficult it is to differentiate between the benign and malignant tumors of bone. He agrees with most observers that the microscopical examination of the tumor is not at all the best index to its character. One must judge from the clinical history and the growth and gross appearance of the tumor. In general, the more cellular and softer and more vascular the tumor the more malignant. As far as the probability of early internal metastasis, one is never able to judge. In tumors apparently of the same character, metastases take place very early in some, in others later. Also, in regard to the malignancy of the tumor, many of these bone tumors, especially of the medulla, clinically run a benign course for a number of years, and suddenly, without any special reason, take on the appearance of malignant growth and give metastases. He cites a case in which for eight years the tumor had every appearance of a benign growth, but internal metastases took place. He agrees with most surgeons that the giant-celled form of sarcoma of the medulla of bone is the most benign, although the giant cells may be present in very malignant tumors. If the tumor is circumscribed and has a definite bony shell, this is an index of its benignity.

As to the investigation of the statistics of cures after the more radical operation—amputation—it is difficult, because many of the patients are not followed up. König has found that 18 per cent. are living without recurrence four years after operation. The number of cases of local recurrence after amputation is few. The question, then, between the more radical operations of high amputation and exarticulation of the highest joint, and the less radical operations of excision of the bone, is entirely one of local recurrence. Of course, if it happens, as Mikulicz suggested, that we are able to get the consent of our patients to operate earlier when we suggest excision rather than amputation, the former plan would probably promise better results in respect to internal metastasis.

I do not believe that either Mikulicz or Weisinger's cases, and others

in the literature, have gone long enough to make a just comparison between the two methods; unquestionably, there are on record a number of cases in which there has been no local recurrence after resection, and the tumors in these cases were, without doubt, as malig-

FIG. 27.



FIG. 28.

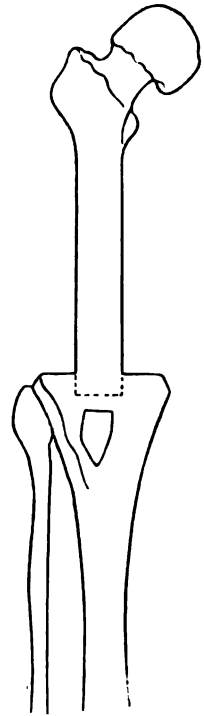


FIG. 27. -- Mikulicz's patient after resection of the femur for sarcoma.  
 FIG. 28. -- Method of approximating the resected bone.

nant and as wide-spread as many in which amputation has been done. Mikulicz reported six cases of excision: two of the radius, one of the ulnar, one of the tibia, in which 10 cm. were removed, and two of the femur (Figs. 27 and 28). In one of the cases of excision of the femur amputation was performed five months later, because of the partial.



union and pain. In the third case in which he attempted excision amputation was necessary because the large vessels of the thigh were involved. Weisinger reports three cases: one at the lower end of the femur, one at the upper end of the tibia, and one at the upper end of the humerus. The tumor in the humerus was a mixed-cell (chiefly spindle-celled) sarcoma, which had already destroyed the head of the bone. The tumor at the lower end of the femur was not localized, the muscles were slightly infiltrated, and the cartilaginous ends of the condyles were perforated in places. The tumor at the upper end of the tibia was a myxochondrosarcoma. In all these cases of resection of the femur or tibia the shortening varied from 10 to 20 c.c.; the union, however, of the resected ends of the bones was in the majority of the cases firm and the patients were able to walk with high shoes. In the resection of the upper end of the humerus, although the shoulder-joint was frail, the patient was able to use the elbow-joint and the hand—a great advantage over amputation.

These cases of Weisinger and Mikulicz have demonstrated that in the upper extremity after extensive resection good functional use of the limb is obtained; and after extensive resection of the bones of the lower extremity, union will be obtained in the majority of cases and a fairly useful leg. The cases, I think, should be observed longer before one is able to compare the probabilities of local recurrence. These two articles of Weisinger and Mikulicz are probably without doubt the best in regard to excision of the bones for malignant sarcoma rather than amputation.

Morton<sup>1</sup> reports two cases of excision of the upper end of the tibia for myeloid sarcoma as a substitute for amputation. He states that he could find no record of a case in which this had been successfully done in a femur or tibia. He had probably overlooked Mikulicz's paper. The union in both of his cases was excellent. The shortening was, I should judge, between 6 and 10 cm. The first patient was operated on in January, 1897, and was free from recurrence in April, 1898, one year and three months after operation. The second patient was operated on in September, 1897, and was free from recurrence in March, 1898, a period of six months. The union in this latter case was not so good as in the first. The patient wears an apparatus. It would appear from the gross appearance of the resected upper end of the tibia, shown in Fig. 29, that the disease was not completely removed and that local recurrence should be expected. It would be difficult to make out from this photograph the exact character of the tumor.

Karewski<sup>2</sup> reports a case of giant-celled sarcoma of the upper end of

<sup>1</sup> British Medical Journal, July 23, 1898.

<sup>2</sup> Berliner klinische Wochenschrift, August 22, 1898.

the tibia cured by chiselling and curetting. The patient was free from recurrence one year and four months after operation. In this patient, a female, aged twenty-six years, there had been a history of trauma six months before. When admitted to Dr. Israel's clinic there was a definite tumor situated over the inner head of the tibia, and this tumor fluctuated. It was punctured and found to be solid, the fluctuation being false, which is very common in soft sarcoma. The gross pathological description is not very clear. The tumor, however, occupied only part

FIG. 29.



Morton's specimen of resection of the tibia for sarcoma.

of the head of the tibia—the inner head. It was very soft, and had broken through into the joint and involved the crucial ligaments; microscopically it was found to be chiefly composed of giant cells. There was a great deal of necrosis in the tumor. At the operation only the inner head of the tibia was removed, the outer being left. The X-ray photograph, taken some time after the operation (Plate IV.), shows that the cavity left after the removal of the tumor has not been filled up with new bone.

Frank Hinds<sup>1</sup> reports a case of giant-celled sarcoma of the lower end

<sup>1</sup> British Medical Journal, February 26, 1898.

**PLATE IV.**



**X-ray photograph after local excision of a giant-cell sarcoma of the inner head of the tibia. (KAREWSKI.)**



of the femur that has not recurred for a period of two and a half years after operation, which consisted of simply chiselling and curetting. The patient was thirty-four years of age. For fifteen months he had pain in the right knee, and later he noticed a swelling. These had not prevented his getting about or working, and his general condition was excellent. The lower end of the femur was enlarged, particularly the inner tuberosity, over which there was slight tenderness. There was no impairment of movement of the knee-joint. A diagnosis was made of osteomyelitis with central necrosis at the lower end of the femur. Hinds says that as soon as the incision was carried down to the bone its thin, expanded condition, with a bluish color of the subjacent structure, showed the nature of the disease. A piece of the cortical bone was removed; it was so thin that it could be cut with scissors. The exposed growth was dark red in color and firm, and was easily scraped out with a sharp spoon. The bleeding, very profuse, was checked by a tourniquet. Removal of the growth left a cavity in the lower end of the femur which involved both condyles, extending upward into the shaft and measuring four inches in depth. After curetting the surface was scrubbed with chloride of zinc solution and packed with gauze. At the end of six weeks the appearance of the granulation in the wound was not satisfactory, and the cavity was again curetted and scrubbed with zinc chloride solution. At this operation the gross appearance did not suggest new growth. Under the microscope the growth removed at the first operation was a "myeloid sarcoma, with numerous giant cells." There was no examination of the tissue removed at the second operation. In a fairly good X-ray photograph of the limb taken some time after the operation a small area in the condyle of the femur, in which the shadow is fainter, can be made out. Judging from the photograph there must have been a good deal of new-bone formation, as the cavity is much smaller than the one described as being made at the first operation.

**Observations on Sarcoma of Long Bones Seen in the Gottingen Clinic from 1880 to 1895.**<sup>1</sup> Reinhardt has collected 54 cases; 19 were situated at the upper epiphysis of the tibia (35 per cent.); 18 at the lower end of the femur; 13 in the humerus; 2 in the ulnar, and 2 in the radius. The most common situation is the upper end of the tibia and the lower end of the femur. He has classified them into three varieties: (1) The pure periosteal, which was rare, 5 cases; (2) a combination of periosteal and medullary, which was the most common, and of these the majority took origin in the medulla; (3) the pure medullary sarcoma, which were more common than the pure periosteal.

In 75 per cent. of the cases the tumor originated on the diaphyseal

<sup>1</sup> Deutsche Zeitschrift für Chirurgie, Band xlvii.

side of the epiphyseal line. Tumors have been most common in middle life; fourteen tumors after forty years of age. It is interesting to note that Reinhardt was able to find that trauma had an indefinite relation to the new growth in nine cases only, and in only one case could heredity be traced. The majority of the patients presented themselves to the clinic six months after the beginning of some symptoms which pointed to trouble in the bone. In the differential diagnosis tuberculosis of bone seemed to present the greatest difficulties. In six cases the diagnosis before operation was bone abscess. In nine of the fifty-four cases the patients came to the hospital with a pathological fracture. It is interesting to note that in thirty-four of the fifty-four cases before a definite diagnosis was made an exploratory operation was performed. In all of these cases amputation was the operation performed. Of the fifty-four, four died; two were hip-joint amputations, one a shoulder.

*The Ultimate Results.* Seven cases (18 per cent.) are well of thirty-nine who were operated on more than four years ago. Local recurrence is rare; in the majority of cases death is due to internal metastasis. In nineteen cases (33 per cent.) it was definitely proven that internal metastasis took place, and in these there was metastasis to the lungs. Without doubt there were other fatal cases which had internal metastases. In many of these cases a diagnosis of tuberculosis of the lungs was made, but an autopsy was not performed. Only six local recurrences were found. From a careful résumé of all the histories, Reinhardt is not able to say that the spindle-celled sarcoma is any more malignant than any of the other cellular sarcoma.

**Carcinomatous Metastases in Bone from Primary Carcinoma of the Prostate.** In the differential diagnosis of tumors of bone one must always bear in mind that the tumor may be a secondary and not a primary one, and especially is this true in adults. Sydney M. Cone<sup>1</sup> reports an interesting case from the clinic of Halsted, and also speaks of the observations of von Recklinghausen in regard to the osteoplastic changes in the bone accompanying metastases from primary carcinoma of the prostate. He reports somewhat in detail six cases from the literature, and gives eleven references. The pathological description, both gross and microscopical, of the case from Halsted's clinic, and even of the cases from the literature, is full and excellent.

The case reported by Cone I also observed. The patient was a man, aged seventy-five years, who had been for some months under observation, both in the dispensary and in the ward, for chronic cystitis with enlarged prostate. He was readmitted to the hospital December 25, 1896, complaining of a painful swelling situated 6 cm. from the lower

<sup>1</sup> Bulletin of Johns Hopkins Hospital, 1898, vol. ix.

end of the tibia. He had noticed the tumor but a few weeks. The tumor was situated above the internal malleolus, on the anterior aspect of the tibia, and the bulging measured about 4 cm. It was covered with periosteum and originated in the medullary cavity. Dr. Halsted, who operated, was struck by the gross appearance, which was more suggestive of carcinoma than sarcoma. Although the patient's prostate was enlarged and we thought of the possibility of a new growth, it could not be demonstrated until the autopsy, which was made later by Dr. Cone. In addition to the primary carcinoma of the prostate, he found metastases to the second, third, and fourth lumbar vertebræ, second rib, and the ileum. The metastases had given no symptoms except, perhaps, slight pain in the back. Cone draws the following conclusions: (1) Tumors like carcinoma in bone without any evident primary focus must lead one to suspect the prostate or thyroid; (2) endothelioma and carcinoma are not readily distinguishable from one another; this is true both macroscopically and microscopically. (3) Statical and traumatic influences are potent in locating the metastasis; (4) the new-bone formation and location of the metastasis are significant of carcinoma of the prostate. The metastases occur by the veins. The organs are rarely the seat of metastasis. The pelvic lymph-glands may not be involved. Very small nodules of carcinoma may give rise to extensive metastasis. There is an extensive new-bone formation, osteoplastic carcinosis, in these metastatic tumors.

Richard Wolff,<sup>1</sup> in a very recent article, considers the great difficulties in the diagnosis of carcinoma of the prostate. He emphasizes the fact that our attention is frequently called to the malignancy of the hypertrophied prostate by the symptoms of its various metastatic foci. Such a diagnosis is, of course, of little value to the patient, except that it might save him from the discomforts of a useless prosectomy or castration. It is to be hoped that we may be able to make a diagnosis of carcinoma of the prostate before the stage of metastases.

Wolff considers in detail the neuralgic symptoms dependent upon metastases to the pelvic and post-peritoneal glands, consideration of which would be out of place in my review. In eighty-three cases of carcinoma of the prostate Wolff found nine with bone metastases. Prostatic carcinomatous metastases, similar to those from the mammary glands, select the larger bones.

**Metastases to Bone from Benign Adenoma of the Thyroid.** In a previous article Cone has called attention to the fact that the prostate and the thyroid are the most common primary seats to give rise to secondary metastasis to bone. In the prostate the primary tumors are

<sup>1</sup> *Deutsche Zeitschrift für Chirurgie*, July, 1899, Band lli., Heft 3 and 4.

always malignant carcinoma, and the metastasis somewhat preserves that type. However, in thyroid tumors not only the malignant adenocarcinoma and carcinoma but the simple colloid adenoma may give rise to wide-spread metastases, and these metastatic tumors, macroscopically and microscopically, always resemble the original tumor, and the majority of the metastases take place in the bones.

Hansel<sup>1</sup> reports a case, and collects the similar cases which heretofore have appeared in the literature—eleven in all. It is a very important and interesting contribution, and brings our knowledge of this most interesting condition up to date. It has been known for some years that the benign colloid adenoma of the thyroid now and then gave rise to metastases, so that when one observes a tumor of a bone the possibility of its being a thyroid metastasis should be borne in mind, and if the thyroid gland is enlarged this idea should make more of an impression. If it is a metastasis from an adenoma of the thyroid, one, as a rule, should recognize the tumor from its gross appearances, which are so characteristic, and if situated in the long bones, one should not resort to amputation, because in the majority of cases the tumors are multiple, and of themselves will not cause death; a local extirpation is sufficient.

### **COXA VARA (CURVATURE OF THE NECK OF THE FEMUR).**

Professor Albert, of Vienna, writing in June, 1899, begins the most recent monograph on coxa vara in the following interesting and instructive manner:<sup>2</sup>

“At the age of puberty the following is sometimes found: One leg is extended in a parallel position or slight adduction and rotated outward; there is real shortening, due to a high position of the trochanter. Motions are partly impeded in such a manner that abduction and rolling in are impossible, while flexion and extension are free. The condition develops gradually and spontaneously, so that only after months is the deformity noted. Walking is very painful, so that the patient has to go to bed frequently and remain there for weeks. In cases of this sort the diagnosis is made—coxitis. Two things are noteworthy in this case: First, the position of the leg does not correspond to that in which coxitis is usually cured; for that reason I wrote in my treatise on coxitis,<sup>3</sup> more than twenty years ago: ‘Exceptionally (I have only seen

<sup>1</sup> Beiträge zur klinische Chirurgie, 1899, Band xxiv., Heft 1.

<sup>2</sup> The translation of this monograph, to be published shortly, was made and furnished me by Dr. Sydney M. Cone. The proof-sheets of the article were supplied to him through the courtesy of Professor Albert. Zur Lehre von der segmentation coxa vara und coxa vulga. Wien., 1899. Alfred Hölder.

<sup>3</sup> Wiener Klinik, 1876, p. 265.



it twice in youths) one finds the leg in beginning coxitis fixed in moderate flexion but strong outward rotation.' I kept the analogous cases in mind, and wrote, after further numerous experiences, that it was characteristic, 'especially in late childhood and at the age of puberty, to find more frequently parallelism and supination.'<sup>1</sup> Second, it was very striking that flexion and extension were possible without concomitant motion of the pelvis. One overlooked this point and continued on the diagnosis of coxitis, keeping the symptoms foremost. What other disease could it be?

"Kocher undertook a resection in such a case, and found the joint perfectly healthy and the condition to be due to a special (peculiar) change in the upper end of the femur. I, too, who did not resect in similar cases, thought that the upper end of the femur was changed. The circumstance that the trochanter was higher and projected very much laterally only allowed of one interpretation—i. e., that the neck of the femur stood horizontally, or even made an acute angle with the shaft; accordingly, I have thought since then that among the many causes of real shortening in coxitis one is to be found in a horizontal position of the neck of the femur. It was very surprising to hear that in these cases we did not deal with coxitis, but that the joint was healthy. A new disease was discovered. I will not write the history of this small chapter. It is well known what Hofmeister, Kocher, von Bruns, and E. Müller did in observing and laying the foundation for the comprehension of the coxa vara as a disease. The previous isolated observations and descriptions have been unearthed and spread abroad since then. I shall, without more ado, say a few things about coxa vara." . . . .

Previous to the contributions of Müller and Hofmeister isolated reports of specimens exhibiting a curvature of the femoral neck appeared in the literature. The writers, until Müller, called no special significance to the deformity, but considered them rare anomalies.

In Hofmeister's first publication, in 1894, Whitman's, in 1894, and Frazer's, in 1898, the following early reports are referred to:

Röser, in 1843, obtained his specimen at the autopsy of a male, aged twenty-four years, who died of tuberculosis of the lungs. During life the deformity at the hip had been considered a dislocation. The deformity had been adduction and flexion. The specimen showed a curvature downward and forward, a normal head not dislocated. Hofmeister is of the opinion that the condition was more likely the result of a chronic tuberculosis. The patient at the age of one and a half years had suffered from an infected wound of the foot, with a secondary abscess in the groin. Scar contraction contributed to the deformity of the hip. The

<sup>1</sup> Lehrbuch, 4 Aufl., Band iv.

much shorter and atrophied limb had never been used. Röser's case is certainly not one of true coxa vara.

Zeis, in 1851, found a museum specimen exhibiting a downward and forward curvature of the femoral neck, but no evidence of any disease of the bone. No clinical history was found with this specimen.

Richardson, in 1857, found the specimen during an anatomical dissection; it was first considered an old fracture of the neck that had healed in a deformed position. There was, however, no evidence of fracture, and Richardson was inclined to attribute the deformity to local and late rickets.

Monks, in 1888, missed his opportunity by making a diagnosis of arthritis deformans in a patient eighteen years of age, who for two years had suffered from pain and stiffness in his hip-joints. The now characteristic symptoms of bilateral coxa vara were present: outward rotation of the limbs, high trochanters, and some restriction of motion. Knock-knee and flat-foot were also present, and the patient walked with a characteristic "rocking gait."

Keetley, in 1888, observed a similar but unilateral case. The girl, aged twenty years, had suffered for eight years with a limp; the trochanter was elevated. Keetley and Sir James Paget (who saw the patient) considered the case a unique one. Later, on account of marked adduction, Keetley performed a subtrochanteric osteotomy, removing a wedge-shaped piece of bone. The piece of bone, Keetley thought, showed evidence of rhachitis, and for this reason he attributed the deformity to rickets.

Hofmeister, in 1894, called attention to the earlier observations of Schede and Stahl (1878) and Oberst (1890) of curvature of the femoral neck associated with osteomyelitis, and to the numerous references to "burden-deformities" at the knee and foot (especially Mikulicz's article, 1879); but a corresponding condition of the femoral neck was not considered.

E. Müller<sup>1</sup> writes that the literature of the coxa vara should begin with Fiorani,<sup>2</sup> who in 1882 reported fifteen cases (all children or young adults). In each case the picture of the deformity due to the curvature of the neck of the femur was recognized and attributed to rhachitis. This publication, which antedated both Monks' and Keetley's, is not mentioned by any writer except Müller, and he did not find the communication until 1897. Whitman, in 1899, refers to Fiorani, also Alsberg, in 1898.

To E. Müller's original communication from the clinic of Professor Bruns, entitled "The Bending of the Neck of the Femur During the

<sup>1</sup> Centralblatt für Chirurgie, 1897, vol. xxiv. p. 1232.

<sup>2</sup> Ibid., 1882.

Period of Growth, a New Picture of Disease,"<sup>1</sup> all writers now give credit as the first discussion of the new disease, called later (1894) by Hofmeister *coxa vara*.

Müller's four patients were from seventeen to nineteen years of age. He describes the disease as one beginning during the period of growth in young people whose occupation placed on their rapidly growing bone too great a strain. In other words, the demand on the skeleton was out of proportion to the strength of the bone at the period of growth, although the bone at the position of bending need not of necessity be the seat of any disease. The affection began, as a rule, gradually with pain and limping. The resulting deformity was elevation of the trochanter with real shortening, slight outward rotation, and limitation of abduction. The limb was straight or slightly flexed, with moderate adduction.

One specimen was obtained by a resection; the joint was normal, and the neck was bent downward at a right angle to the shaft. Microscopical section showed no evidence of disease.

Frazier,<sup>2</sup> 1898, reports two cases of *coxa vara* observed by him in the Howard Hospital, of Philadelphia—a girl, aged nineteen years, and a child of eight years. The subject is fully discussed, with references to all the literature. Frazier collects and publishes the histories of forty-one cases which have been reported since Hofmeister's article in 1894. Hofmeister's<sup>3</sup> article was read before the Twenty-third German Congress, and the designation of "*coxa vara*" or "*collum femoris varum*" for the deformity of the femoral neck was suggested.

Hofmeister collected 45 cases (Müller's original 4 cases observed in Professor von Bruns' clinic at Tübingen, 32 cases observed since by Hofmeister in the same clinic, 3 cases sent by Müller from Stuttgart, 1 case observed by Fischer in army recruiting, and 5 cases from the literature of Rotter, Strubel, Lauenstein, and Schultz). Stimulated by Müller's observation, Hofmeister sent for and examined many old cases, in whom coxitis had been diagnosed and treated, and from these patients he was able to isolate a number which clinically belong to *coxa vara*. Hofmeister stated that during the last five years (1889 to 1894), while 47 cases of *genu valgum* have been observed in the clinic, 22 cases of *coxa vara* have also been recognized. Based on the forty-five cases Hofmeister elaborated the now characteristic features of the clinical course and symptoms of *coxa vara*, but adds little to the pathology, because no specimens were obtained either by operation or autopsy. It is remarkable how much Müller was able to learn from his four cases and one

<sup>1</sup> Beiträge zur klinische Chirurgie, 1887, Band iv., S. 137-148.

<sup>2</sup> Annals of Surgery, July, 1898, vol. xxviii. p. 21.

<sup>3</sup> Beiträge zur klinische Chirurgie, 1894, Band xii. p. 247.

specimen. Hofmeister's observations confirm Müller, and in addition give us a more comprehensive view of the disease.

*The age of onset* in these 45 patients varied from two to twenty years ; 9 between two and thirteen years ; 30 between thirteen and twenty years ; 1 over twenty years. The largest number (14 cases) were about fifteen years of age. Hofmeister, therefore, recognized *coxa vara infantum* and *adolescentium*. He did not observe any congenital cases.

FIG. 30.



Coxa vara congenital. (KREDEL.)

Kredel,<sup>1</sup> 1896, was the first to observe cases of congenital coxa vara. Two cases are recorded, one bilateral and one unilateral. Kredel believes that pressure from bad intra-uterine position is the cause of the deformity (Fig. 30).

Kirmisson, according to Frazier,<sup>2</sup> reported cases of congenital coxa vara.

The following table is based on Hofmeister's and Frazier's article :

<sup>1</sup> Centralblatt für Chirurgie, 1896, vol. xxiii.

<sup>2</sup> See Frazier's article, Cases 35, 36 and 37, Annals of Surgery, 1898, vol. xxviii. Frazier's reference, however, is to the Revue d'Orthopédie, 1894, No. 5, instead of September, 1897.

Tables of ages in coxa vara (from Frazier's article).	Hofmeister.	Frazier.	Total.
Congenital . . . . .	0	4	4
2 to 5 years . . . . .	1	5	6
6 " 7 " . . . . .	2	3	5
7 " 8 " . . . . .	1	1	2
9 " 10 " . . . . .	1	6	7
10 " 11 " . . . . .	1	0	1
12 " 13 " . . . . .	3	0	3
13 " 14 " . . . . .	4	0	4
14 " 15 " . . . . .	3	8	11
15 " 16 " . . . . .	14	5	19
16 " 17 " . . . . .	5	6	11
17 " 18 " . . . . .	3	0	3
18 " 19 " . . . . .	1	0	1
20 " 21 " . . . . .	1	0	1

**Onset.** Coxa vara, as a rule, begins without apparent cause (except now and then after a trauma) in children, but more commonly at the beginning of puberty, with a slight pain in the hip, which may be referred to the knee, followed shortly by a limp. The symptoms increase gradually until the deformity is more marked. More or less restriction of motion is present. A trauma received at any time may increase the symptoms.

**Deformity.** The bending of the neck is usually downward and backward (following the line of least resistance), occasionally downward only and more rarely downward and forward. The downward bending of the neck shows itself in the elevation of the trochanter, and is accountable for the real shortening of the leg and the limitation of abduction. This was present with only one exception. The backward bending of the neck moves the trochanter backward and produces the outward rotation and limitation of internal rotation. These two conditions are both present in a majority of the cases.

The following table, taken from Frazier's<sup>1</sup> article, shows the variation in the position of the limb in thirty-six of Hofmeister's cases and in thirty-two collected later by Frazier :

Position of limb.	Hofmeister.	Frazier.	Total.
Outward rotation . . . . .	27	16	43
" " and adduction . . . . .	1	5	6
" " and flexion . . . . .	0	5	5
Inward rotation . . . . .	1	1	2
" " and adduction . . . . .	1	1	2
Adduction . . . . .	0	1	1
" and flexion . . . . .	1	0	1
Normal . . . . .	5	3	8

<sup>1</sup> Annals of Surgery, 1898, vol. xxviii. p. 31.

Hofmeister divided coxa vara in three groups, as follows (taken from Frazier's article) :

*Group I.* Elevation of the trochanter and limited abduction are the characteristic features. The attitude of the limb is usually normal, flexion and rotation being either normal or limited to a slight degree.

*Group II.* Elevation of the trochanter and outward rotation. In addition to the limited abduction associated with cases in Group I., we find in this group that inward rotation is so restricted that it is impossible to rotate the limb further inward than to a position in which the foot points directly forward. Outward rotation may be possible only to a

FIG. 31.



Bilateral coxa vara (Whitman's case).

normal degree, or so far beyond the normal that the patella and foot may point not only directly outward but backward. Abduction and adduction are as described in Group I., the former being markedly restricted or altogether abolished, the latter entirely free. In the majority of cases flexion is unrestricted, except when attended with outward rotation and adduction of the thigh—that is to say, if one attempts to flex the limb he must at the same time adduct it and rotate it outward, or he will soon come to a point where further flexion is restricted. If the affection is bilateral it is now easily understood why, when both thighs are flexed simultaneously, each leg will cross over its fellow (Fig. 31). The appearance of such a patient is also quite characteristic, and it is commonly spoken of as the “scissor-legged deformity.” The gait is not unlike

that seen in cases of bilateral congenital luxation of the hip. Through the cooperative effect of outward rotation and limited abduction in bilateral cases there exist certain characteristic restrictions in the movements of the leg. For example, such a patient can kneel only with the legs crossed. The explanation of this is apparent: flexion is only possible when the limb is rotated outward, and spreading of the thighs

FIG. 32.



FIG. 33.



Clinical picture of coxa vara adolescentium. (HOFMEISTER.)

(which would obviate the necessity of crossing the legs) is quite impossible, since abduction is restricted. For the same reason sitting on a stool with the legs close together is impossible, and stooping over to pick an object off the ground is difficult. The *rationale* of this is appreciated when, by voluntary limiting abduction and rotating the limb

outward, we try in our own persons to touch the floor with our hands. Such an act is only made possible by the preternatural mobility of the vertebral column.

Of the three groups the large majority of cases belong to Group II. ; of fifty-five cases tabulated by Hofmeister, forty-four belong to this group, eight to the first, and three to the last, now to be described (Figs. 32 to 37).

FIG. 34.



FIG. 35.



Clinical picture of coxa vara adolescentium. (HOFMEISTER.)

*Group III.* Elevation of the trochanter and inward rotation. The functional disturbances of this group correspond with those of Group II., with this exception—namely, in one we find inward and in the other outward rotation. One of Hofmeister's cases (No. 9) was the only one



which could hardly be placed in any of these groups. Outward rotation was present, but the trochanter was not elevated (the only exception); the limb was abducted, and adduction was impossible.

Sporadic cases of bilateral coxa vara are recorded. The disease usually begins on one side. Coxa vara always tends toward a spontaneous recovery, although the resultant deformity may be very marked. Remissions are very uncommon.

FIG. 36.



FIG. 37.



Clinical picture of coxa vara adolescentium. (HOFMEISTER.)

**Etiology.** Hofmeister agrees with Müller in considering coxa vara a deformity due to overburdening, and draws its analogy with genu valgum infantum and adolescentium.

Rickets in the infantile form or late rhachitis in the adolescent form may be associated, although, especially in the adult form, a history or an anatomical evidence of rhachitis is, in the majority of cases, absent.

**Coxa Vara Traumatica.** Sprengel<sup>1</sup> has suggested this name for those cases in which the deformity is caused by a fracture between the head and neck of the femur at the epiphysis. In Sprengel's two specimens, obtained by resection, the head was slightly or completely dislocated and united to the neck in a deformed position.

The findings in his two cases are so carefully worked out that his publication is, without doubt, the most important one on traumatic coxa vara. In a study of the possibility of a differential diagnosis between Sprengel's traumatic coxa vara and true traumatic coxa vara due to the bending of the neck from overburdening these two cases demonstrate the difficulty and perhaps the impossibility of such a differentiation.

In both of Sprengel's cases the presence of a fracture between the head and the neck as the cause of the deformity was not recognized until a section had been made of the resected specimens. The history, the clinical appearance, and the gross examination of the resected specimens, and the X-ray photographs, all were consistent with a diagnosis of coxa vara adolescentium. At first both patients denied a trauma, and gave a history of pain in the hip followed by limping and shortness of the leg as the beginning of the trouble. Some time later, when Sprengel had demonstrated anatomically the presence of a fracture, he questioned both patients more critically for the history of a trauma. The first patient stated that he had denied the slight trauma at first for fear of his father; the second patient acknowledged a trauma, but it was so slight that on the previous occasion it had slipped his memory. In both cases, however, the symptoms began subsequent to the injury. Both patients were males, aged seventeen and nineteen years respectively. In the first case the history of trauma obtained later was as follows: The patient was walking and carrying a heavy load. In lowering this weight to the ground he was bent over suddenly, and with a good deal of force, to the left. Immediately he felt a severe pain in the left hip, and for a few minutes was unable to walk at all. Later, he succeeded in limping to his home. The next day he was able to walk a short distance to consult his physician, who considered that the injury was an ordinary sprain, and urged the patient to continue at work and walking, which he did. The pain in the hip continued and grew worse from the limping, and the patient noticed a distinct shortening of the leg. Examination: The patient walks with difficulty with the aid of a cane. The left leg is abducted and rotated out. The left pelvis is tilted upward 5 cm. The left trochanter is situated higher than its fellow and is rotated out. There is slight atrophy of the muscles of the thigh and restricted motion at the hip-joint in every direction. When the patient was examined under an

<sup>1</sup> Archiv für klinische Chirurgie, 1898, Band lviii.

anæsthetic the restriction of motion was still present. At the operation, after an exploratory incision exposing the pelvis and the head and neck of the femur, it could easily be made out that the deformity was between the head and the neck, and that the head of the femur was slightly dislocated. Resection was performed between the neck and the trochanter, and the trochanter was then placed in an acetabulum and the limb placed in a marked abducted position and fixed in plaster.

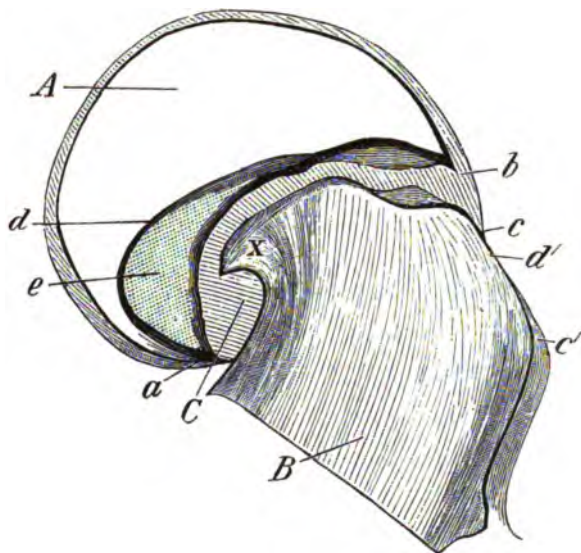
In the second case the following history of trauma was obtained: The patient while playing on a stone floor fell on his right hip. From that moment he felt pain and found he could not walk. He remained in bed about twenty-four hours. From this time on there have been pain in the hip, slight limping, and he has noticed that the right leg is shorter. Examination: The right leg is rotated out and *abducted*. There is slight flexion. The right half of the pelvis is 2 cm. lower. The right trochanter is higher and rotated backward (the position of abduction and slight flexion has been recorded before as an exception to the rule in coxa vara (Hofmeister). On examination under ether it was found that the motions in the hip-joint were limited in all directions, and on exposing the parts to view it was found when the leg was strongly rotated out that the angle of bending was between the head and neck of the femur and that the head was slightly luxated.

These clinical pictures are the usual ones in adolescent coxa vara. The duration of the disease, if the history of trauma is overlooked, is somewhat shorter than usual, and the deformity, abduction, and flexion present in Case II. is an unusual one. Both specimens were examined most completely (both gross and microscopical appearances), and Sprengel has demonstrated without doubt (the anatomical examination was made by Dr. Benicke) that there was a fracture between the head and the neck of the femur in the epiphyseal line. In both cases the head is dislocated (more in Case II.) and has become united to the neck of the femur in the new and deformed position. The head fits over the neck of the femur something like a mushroom over its stalk (similar to Kocher's specimens). Microscopically, in the line of fracture, definite callous tissue was found, in which were scattered areas of hemorrhage and small fragments of necrotic bone and cartilage, clearly demonstrating that the tissue between the head and neck was not the widened and bent epiphyseal cartilage. The line of fracture was partly in the epiphysis and partly in the diaphysis, corresponding to the usual direction of epiphyseal fractures. Fig. 38 is an excellent diagram of the specimen in Case I. and Fig. 39 of the specimen in Case II. *C* represents the callus between the head and the neck.

Sprengel enters into a most interesting discussion in regard to the position of the fracture, whether at the epiphysis or in the neck in chil-

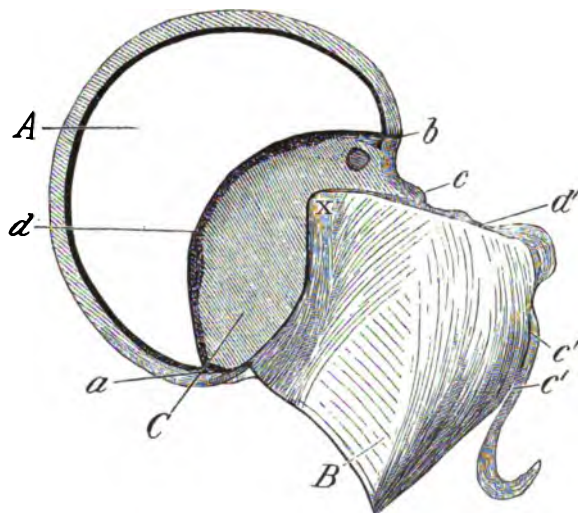
dren and young adults. A fracture in the line of the epiphysis between the head and the neck has previously, and even at the present time, been

FIG. 38.



Specimen of coxa vara traumatica. (SPRENGEL.)

FIG. 39.



Specimen of coxa vara traumatica. (SPRENGEL.)

considered a very rare accident. In 1886, Bruns made the following statement, which has always been considered authoritative: Among eighty-one epiphyseal fractures he was able to find only one situated in

the epiphyseal line between the head and neck of the femur. This case was reported by Bousseau in a boy, fifteen years of age, who had been run over. The trauma had, therefore, been direct; and in addition to the epiphyseal separation of the head of the femur, there were other fractures of the pelvic bone. Tubby,<sup>1</sup> in 1894, compiled from the literature fourteen cases. He, however, considered that in nine cases only was the diagnosis without doubt, and in one only of these nine cases was the diagnosis confirmed by anatomical examination. Sprengel has found that this one case referred to by Tubby was that case of Bousseau already reported by Bruns.

König, in his text-book in 1894, states that Hamilton and Hutchinson report cases of epiphyseal fracture of the head of the femur. In these cases the diagnosis was made after a recent injury, and as all the patients recovered with good function there has been no anatomical proof. Helferich, in his book on *Fractures*, in 1897, states that the injury is a very rare one. I find in a later edition of the same author (1899), page 101, this statement: "Traumatic separation of the epiphysis of the head of the femur is an extraordinarily rare injury, contrasting in this respect markedly with the head of the humerus." Whitman<sup>2</sup> has collected ten of his own cases in children between the ages of two and a half and eight years. At that time Whitman was of the opinion that the fracture in these cases was situated not in the epiphysis but in the neck of the femur. In the majority of the cases the fracture was not complete, but partial or simply a bending (green-stick fracture). Sprengel, however, states that in Whitman's cases there is no anatomical proof. Whitman believes that the differential diagnosis between the fracture of the neck and the epiphysis lies in the fact that in fractures of the neck which are situated more outside or completely outside the capsule the restriction of motion is less. Sprengel states that the following is very suggestive. In 23 cases already mentioned (Tubby, 9; Whitman, 10; Kocher, 2; Sprengel, 2) in 5 cases only was the position of the fracture demonstrated by anatomical examination: Kocher, 2; Sprengel, 2; Bousseau, 1. And in each of these five cases the fracture was situated not in the neck but in the epiphysis between the head and the neck. These observations must influence us in believing that perhaps the majority of fractures in this locality occurring in children or young adults are situated in the line of the epiphysis.

Sprengel then discusses the possibility of a differential diagnosis between traumatic coxa vara and true coxa vara. He links with the term true coxa vara Müller and Hofmeister, and states that in these cases the deformity is a bending of part or the whole of the neck of the femur.

<sup>1</sup> *Annals of Surgery*, March, 1894.

<sup>2</sup> *Ibid.*, 1894.

With traumatic coxa vara he associates the name of Kocher and Sprengel, and states that the deformity is not in the neck but between the neck and the head of the femur, due to a fracture at the epiphysis and the luxation of the head, the luxated head having become secondarily united to the neck of the femur in a new and abnormal position. The majority if not all the writers on coxa vara state that this differential diagnosis is very difficult and perhaps not possible. Hofmeister says that the history of a trauma is the only point of value in the differential diagnosis. Hofmeister states that he believes that the X-ray photograph will aid in the differential diagnosis. Sprengel does not agree with Hofmeister, and I believe that this question is not yet settled. Sprengel concludes with the following very suggestive observation. He states that traumatic coxa vara Kocher-Sprengel, in which the deformity is not in the neck of the femur but between the head and the neck, has frequently the same clinical history as have the cases of coxa vara Müller-Hofmeister. In many cases the trauma is so slight that the observers have not considered it as the cause of the disease, and in many cases, unless it has been sought for, this slight trauma has been overlooked by both patient and surgeon. The deformity produced by coxa vara Kocher-Sprengel is the same. As yet it is not conclusive that the X-ray shadow gives a differential picture.

In view of these facts (which appear to me to be entirely correct) it is impossible to state that the deformity is due to a bending or to a fracture unless careful anatomical examination has been made. Therefore, as Sprengel states, many of the cases already recorded in the literature as true coxa vara, and in which there has been no anatomical examination, may be examples of coxa vara traumatica.

In the differential diagnosis Sprengel calls attention to the limitation of motion in his two cases, which he thinks may be an important point, indicating a traumatic coxa vara. He believes that the limitation of motion will be increased as the point of the bending of the neck of the femur is nearer the head, especially when this is in the line of the epiphysis of the head. The partially luxated head in these cases, with the shortened neck due to the overriding of the neck by the head (mush-room position), is the cause of the restriction of motion.

Sudeck,<sup>1</sup> 1899, writes from the clinic of Professor Kümmel, in Hamburg, on the anatomy and etiology of coxa vara adolescentium. Sprengel's two specimens conclusively prove the possibility of coxa vara traumatica (Kocher-Sprengel), in which the seat of bending is between the neck and head, and the head is dislocated and overrides the neck in its abnormal position. Sprengel believes that anatomical examination will demon-

<sup>1</sup> Archiv für klinische Chirurgie, 1899, Band lix., Heft 2.

strate a fracture in the majority of cases, and that clinically the more restricted motion may (later) be found to be a differentiating symptom, and that the X-ray photograph, which shows the dislocated and mushroom head, will also aid in the diagnosis. Sudeck's specimen and anatomical studies entirely deal with the (true) coxa vara adolescentium of Müller and Hofmeister. Here the bending is situated in the neck. The cause is neither trauma nor disease, but a bending of a normal bone during the period of growth from overburdening. Unfortunately, Sudeck's specimen, found in a museum, was preserved without any clinical history. Yet Sudeck is convinced from his anatomical study that the specimen is an example of true coxa vara adolescentium.

The specimen (Fig. 40) shows a bending backward of the neck (similar to Kocher's specimen); apparently there is no bending downward. In the photograph the angle appears increased; this, however, is due to the taking of the photograph obliquely from above. The posterior surface of the neck exhibited a uniform curve and absolute shortening, while the curvature of the anterior surface is marked by a sharp ridge from which the neck extends almost straight toward the shaft and head. To this ridge, crest, or spur (*Knochenleiste*) Sudeck draws special attention. It is clearly marked in the specimen, and extends from the border of the articulating cartilage of the head over the anterior surface of the neck outward and downward. Attention has been called to the ridge by Hofmeister and Kocher, and was considered to be secondary to the bending of the neck.

Sudeck in his anatomical studies finds that the ridge is always to be made out in the normal adult bone, and is pictured in anatomies, but not mentioned in the text. He finds this ridge in the photographs of many of the specimens of coxa vara. The remainder of the article is a discussion of Sudeck's anatomical studies of the system of the bone lamellæ of the upper end of the femur. Two systems are present: one on the adduction side, which sustains the weight of the body (the pressure-bow system), and one on the trochanter side, which sustains the tension (tension bow). This bony crest represents the highest and strongest part of the tension bow, and prevents a bending down and back of the neck. Coxa vara may be considered due (hypothetically) to an insufficiency of the tension bow, which allows a bending of the neck backward and downward. The insufficiency may be caused by a softening or late ossi-

FIG. 40.



Specimen of coxa vara adolescentium. (SUDECK.)

fication of this system of lamellæ, or to an overburdening during its period of growth, when the lamellæ have not acquired their normal adult firmness.

Whitman,<sup>1</sup> 1899, reports twenty-six additional cases of coxa vara observed since his first report of four cases in 1894. During this period he has also observed fourteen cases of traumatic coxa vara (fracture of the neck of the femur in children). Whitman, however, has had no opportunity to examine any specimens, and for this reason adds nothing to the pathology of the disease. His careful description of the disease still agrees with that in the original article of Müller and Hofmeister.

**Differential Diagnosis.** The fact that coxa vara is, as a rule, an acquired deformity, distinguishes it from congenital dislocation. The abnormal mobility of the joint, allowing the trochanter to be moved up and down, and the palpation of the dislocated head distinguish the congenital luxation from congenital coxa vara. From osteomyelitis, tuberculosis, and acute inflammation of or about the hip-joint Whitman says the diagnosis is, as a rule, easily made. The early symptoms of inflammation, the late appearance of the deformity, and the signs of suppuration exclude coxa vara. Nevertheless, I would call attention to the not uncommon fact that insidious cases of tuberculosis resemble cases of coxa vara, and that epiphysitis of the upper femur often runs a very chronic course, with no evidence of inflammation or any suppuration, and the first sign may be a deformity due to the bending of the bone softened by the osteomyelitis. Deformities like coxa vara due to actual diseases (tuberculosis, osteomyelitis, rhachitis, osteomalacia, etc.) can in many instances be differentiated only by the examination of the bone at the seat of the curvature. Whitman says that the history of an accident should differentiate true coxa vara from a fracture of the neck. Sprengel's two cases prove the great difficulty of such a differential diagnosis, and demonstrate that only the anatomical study can make it. Many observations record the onset of very acute symptoms in latent coxa vara after trauma, and, as Sprengel says, it is practically impossible to tell whether there is a fracture or that the symptoms are only due to the aggravation of a latent coxa vara. Whitman summarized his 26 cases as follows: Males, 20; females, 6—bilateral, 5; right hip, 14; left hip, 7. In 3 cases the curvature of the neck was forward as well as downward; in 24 cases backward. Age of onset: Adolescents, 12; late childhood, 8; childhood, 5; unknown, 1.

Of the relation of coxa vara to rhachitis Whitman says: "One case was brought for treatment during the course of infantile rhachitis, and in eight others there was evidence of former rhachitis in early childhood."

<sup>1</sup> New York Medical Journal, January 21, 1899.



**Treatment.** Whitman has subjected 5 cases to operation; 3 to a cuneiform section from the base of the trochanter; 2 of the cases were traumatic coxa vara. In two cases a linear osteotomy below the trochanter minor was done. The ultimate results in all have been excellent. In early cases conservative treatment has given good results.

**Pathology.** Frazier collected from the literature 16 cases in 1898. Since then I find 3 more (Sprengel, 2; Sudeck, 1). These specimens were obtained by operation or at autopsy. The curvature of the neck was associated with supposed rhachitis in 3 cases; with juvenile osteomalacia in 2 cases; with arthritis deformans in 2 cases; fracture of the neck of the femur, 2 cases; congenital, 3 cases, and in 7 cases microscopical examination of the bone showed no changes which could be attributed to any known disease.

The specimens of Zeis, Richardson, Keatley, and Miller have already been referred to. Miller's is the first complete description. Microscopical examination showed no evidence of disease.

Lauenstein,<sup>1</sup> 1890, in an article entitled "Remarks on the Angle of Inclination of the Femoral Thigh Neck," reports an autopsy on a boy, aged six years, who died of tuberculosis of the lungs four months after an osteotomy of the femur and tibia for rhachitic deformities. Before death no note had been made of any deformity at the hip. At the autopsy both femoral necks showed peculiar curvatures. Microscopical examination showed the bone changes of rhachitis. This observation represents the infantile form of coxa vara, which so far is much more frequently associated with rhachitis than the coxa vara adolescentium of Müller and Hofmeister. Lauenstein considers his observation analogous to Müller's.

Schultz,<sup>2</sup> in 1891, reported a case in which Professor Hoffa performed a subtrochanteric resection. E. Müller reviews this article,<sup>3</sup> and considers Schultz's cases analogous to those reported by him. The patient was a healthy girl, thirteen years of age, who without any apparent cause had been limping on the right leg for eleven years. There was no history nor clinical evidence of rhachitis. Before the onset of limping the child had suffered from some inflammatory condition of the upper thigh; an abscess formed, ruptured, and healed. Epiphysitis, with separation and healing at a deformed position, was considered. The real shortening of 7 cm. in the shaft of the femur was accounted for by the restriction of growth which frequently follows epiphysitis. The resected specimen (Fig. 41) showed a marked curvature of the neck backward; a bending upward was not present, and clinically the position of the trochanters

<sup>1</sup> Archiv für klinische Chirurgie, Band xl.

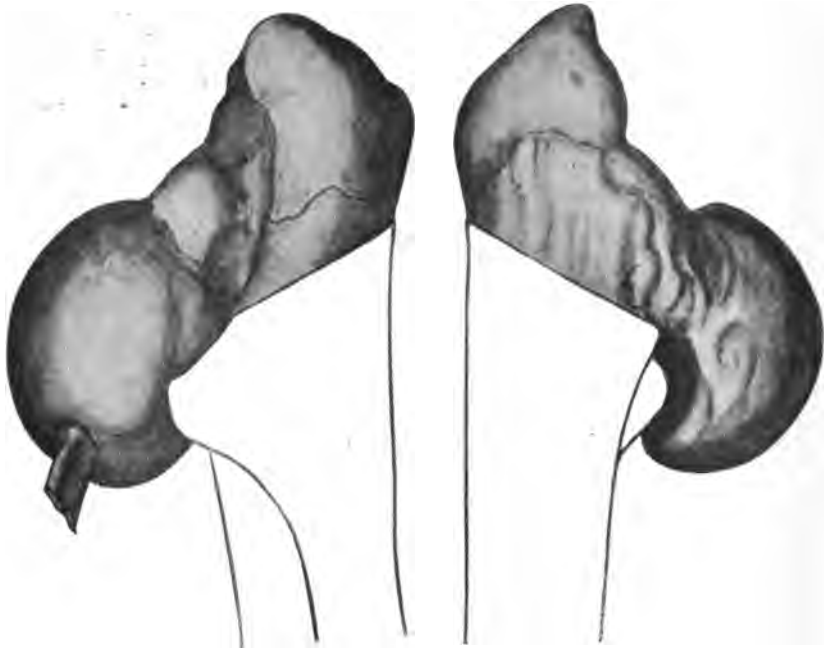
<sup>2</sup> Zeitschrift für orthopädisch Chirurgie, 1891, Band i., Heft 1.

<sup>3</sup> Centralblatt für Chirurgie, 1891, vol. xviii. p. 830.

was not changed. Microscopically the bone showed no change except that which could be explained by pressure. Schultz and Hoffa were inclined at that time to attribute the bending to a late localized rhachitis.

Kocher<sup>1</sup> obtained his specimen by resection below the trochanter. Microscopical examination showed nothing except irregular islands of cartilage, and the line of the epiphysis could not be made out. Kocher is inclined to consider this histological condition one of juvenile osteomalacia.

FIG. 41.



Posterior view. Anterior view.  
Showing deformity of neck. (From specimen of SCHULTZ.)

Kirmisson's<sup>2</sup> specimen was removed from an infant at the post-mortem table. The neck was bent backward. Microscopical examination of the bone was negative.

Sprengel's two specimens, in which a fracture at the head epiphysis was demonstrated, and Sudeck's specimen I have already described.

Hermann<sup>3</sup> reports three cases from Rydyger's clinic. In the third case resection was performed. I have been unable to get the original article, which contains a description of this specimen.

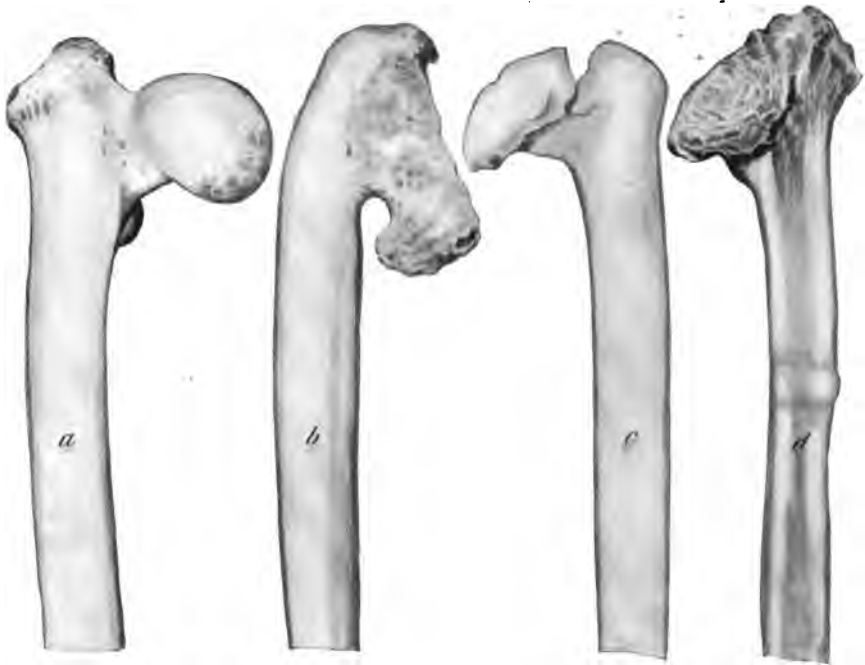
<sup>1</sup> Deutsche Zeitschrift für Chirurgie, 1894, Band xxxviii.

<sup>2</sup> Frazier. Annals of Surgery, 1898, vol. xxviii

<sup>3</sup> Centralblatt für Chirurgie, 1897, vol. xxiv.

Maydl,<sup>1</sup> 1897, adds to the pathology of coxa vara from resected specimens; two of arthritis deformans juvenalis and two of coxa vara adolescentium; in one case complicated by joint changes. This observation adds another factor in the differential diagnosis. Maydl states that the complex of symptoms in coxa vara and arthritis deformans so clearly resemble each other that the diagnosis is made only at the operation. Fortunately, arthritis deformans during the age of puberty is very rare, and I should judge that the disease resembles only the very advanced cases of coxa vara, in which an exploratory operation is always justifiable (Fig. 42).

FIG. 42.



Specimens of arthritis deformans. (ALSBERG.)

Alsberg,<sup>2</sup> 1898, discusses chiefly the anatomical and clinical picture of coxa vara; he has made a careful study of the angle between the neck and the shaft of the femur and describes the proper method of measuring the angle, both in normal and abnormal specimens (Fig. 43).

Alsberg considers coxa vara an anatomical condition which may be associated with many pathological conditions, as follows:

I. Coxa vara congenital.

1. Associated with congenital deformities of the hip.
2. As a concomitant with a congenital dislocation of the hip.

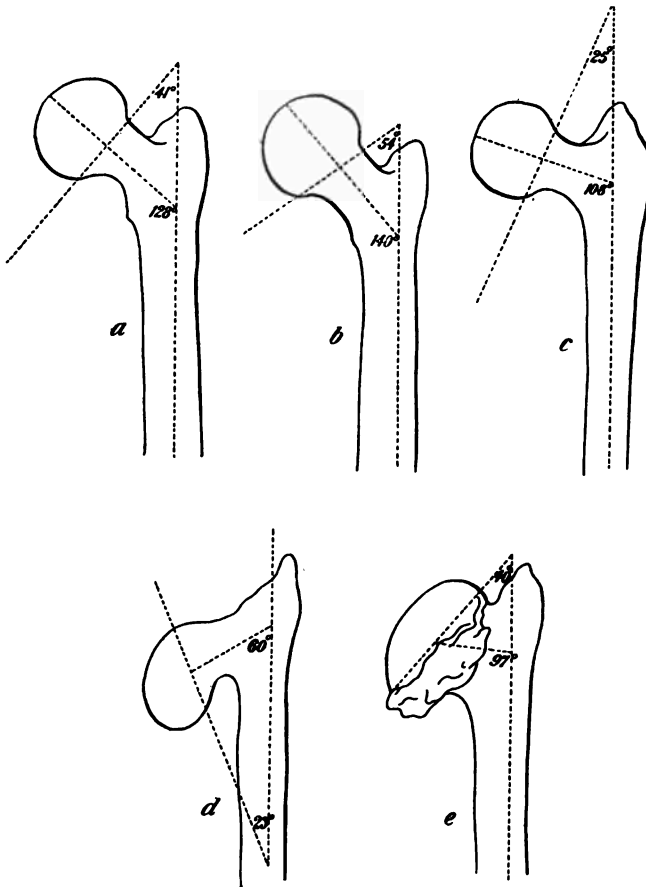
<sup>1</sup> *Centralblatt für Chirurgie*, vol. xxiv., review; *Wiener klinische Rundschau*, 1897, Nos. 19 and 12, original.

<sup>2</sup> *Zeitschrift für orthopädisch Chirurgie*, 1898, Band vi., Heft 1; also editorial by Frazier in *Annals of Surgery*, January, 1899.

## II. Coxa vara as an acquired condition.

1. Rhachitis.
2. A disease of adolescence.
3. Osteomalacia.
4. Ostitis fibrosa.
5. Osteomyelitis.
6. Tuberculosis.
7. Arthritis deformans.
8. Traumatism.

FIG. 43.



Alsberg's system of measurement.

The above is based partly upon Alsberg's publication in 1898; in the majority of cases, however, I have read the original articles. Alsberg gives seventy-six references to the literature.

**Relation of Coxa Vara to Rhachitis.** If the possibility of recurrent or late localized rhachitis is granted, then some cases of coxa vara ado-

lescentium could be attributed to this condition. So far no specimen of the adult variety has been observed in which the bone showed undoubted rhachitic changes. Richardson's specimen is not conclusive. Lauenstein's specimen proves the relation between rhachitis and infantile coxa vara. The observations of Fiorani, Lesser, Ogston, Zender and others show that many, but perhaps not the majority of cases of coxa vara infantum, exhibit undoubted signs of rhachitis.

**Relation of Coxa Vara to Osteomalacia.** Hofmeister<sup>1</sup> reported an undoubted (clinically) case of bilateral coxa vara in a woman during whose fifth pregnancy osteomalacia developed. The deformity could be explained only by the bending of the femoral necks. Hofmeister calls attention to the well-known observation that the bones of the lower extremity are frequently attacked, both in puerperal and other forms of osteomalacia, and that the deformity due to the curvature of the neck of the femur may have been frequently overlooked.

Kocher was inclined to consider the histological changes in his two specimens due to localized osteomalacia.

**Relation of Coxa Vara to Ostitis Fibrosa.** Küster<sup>2</sup> records the only specimen of curvature of the femoral neck associated with this pathological condition. The most recent article on ostitis fibrosa, or, better, fibroplastica, is by Franke.<sup>3</sup> I have already discussed the relation of ostitis fibroplastica to the bending of bone in certain cases of osteomyelitis.

**Relation of Coxa Vara to Osteomyelitis.** Older observations of Volkman, Schede, Oberst, and Diesterweg have recorded cases of curvature of the femoral neck associated with osteomyelitis. The bending is more apt to take place during the acute stage, and Oberst remarks that this curvature is rarely found, because in the majority of cases the patients are confined to bed during this period. More recently von Bruns and Hansell,<sup>4</sup> in their report of 106 cases of acute osteomyelitis of the upper end of the femur, have observed various curvatures of the neck and various deformities between the head and the neck of the femur. They refer to the observations of the authors just mentioned, and state that bending of the neck is frequent, and they have classified their cases into three types: (1) Inward and downward bending of the whole upper end of the femur, including the trochanter; (2) inward bending of the neck at the base of the trochanter; (3) rolling inward of the head and neck toward the lesser trochanter. Clinically, the deformity in many of their cases corresponded with the most common one in coxa vara.

<sup>1</sup> Beiträge zur klinische Chirurgie, 1895, Band xiii.

<sup>2</sup> Verhandlung des Chirurgie Congresses, 1897.

<sup>3</sup> Archiv für klinische Chirurgie, 1899, Band lix., Heft. 1.

<sup>4</sup> Beiträge zur klinische Chirurgie, 1899, Band xxiv., Heft 1.

**Relation of Coxa Vara to Tuberculosis.** No specimen has as yet been observed which proves beyond a doubt that true coxa vara is associated with tuberculosis. Hofmeister was of the opinion that the deformity in Röser's specimen was the result of chronic tuberculosis. Clinically, the deformity in many cases which have been called tubercular coxitis resembles in every detail true coxa vara, and as Hofmeister and Albert say, these cases should not be considered tuberculosis of the hip, but coxa vara. So far, examinations of such cases at operation or autopsy have excluded tuberculosis.

**Relation of Coxa Vara to Arthritis Deformans.** Maydl has shown that, clinically, arthritis deformans juvenalis and coxa vara adolescentium cannot be differentiated. He was only able to make the diagnosis at operation. I have under observation at this writing an adult male, thirty-four years of age, showing the characteristic clinical picture of coxa vara. The condition has been of slow progress during a period of about four years. In the X-ray photograph the head of the bone cannot be made out. The patient reacts to tuberculin. The diagnosis, I believe, lies between fracture, tuberculosis, and arthritis deformans.<sup>1</sup>

**Relation of Coxa Vara to a Disease of Adolescence.** The studies of Müller, Hofmeister, Kocher, Whitman and many others record cases of coxa vara in which, clinically, any as yet known disease is excluded. Among these cases there are on record seven specimens in which the histological findings are negative. Kocher, in his first publication, was inclined to attribute the disease to a special profession, but the more numerous observations of Hofmeister and others demonstrate cases of coxa vara in numerous professions. In the majority of cases the work of the individual is out of proportion to the strength of the bone during the period of growth. The most recent work by Sudeck is an attempt to explain, anatomically, the cause and the position of the bending from overburdening.

**Relation of Coxa Vara to Traumatism.** Sprengel's most recent work proves without doubt that a fracture between the head and neck of the femur at the epiphysis can produce a clinical picture which cannot be distinguished from true coxa vara. A history of trauma directly followed by the symptoms of the disease would suggest coxa vara traumatica, but Sprengel believes that only an anatomical examination will conclusively demonstrate the correct etiology.

The truth of Sprengel's statement was lately demonstrated in a case observed by Dr. Finney in the Johns Hopkins Hospital. The patient was a boy, seventeen years of age. He remembers no trauma except a slight fall from his bicycle five weeks before, since which time he has

<sup>1</sup> At the operation I found a fracture similar to Sprengel's case.

had pain in the hip and has walked with a limp. The examinations showed marked outward rotation and true shortening due to the elevation of the trochanter (2 to 3 cm.). The affected left leg was held fixed in a slightly flexed position. A positive diagnosis was not made. At the exploratory operation by Dr. Finney, under ether anæsthesia, a fracture at the head epiphysis was found. The neck and shaft of the femur were rotated outward and drawn upward. There was very little union between the dislocated head and the neck. Dr. Finney was able to reduce the deformity, placing the neck in a correct position on the head. The wound was closed and the limb fixed in plaster in slight flexion, inward rotation, and slight abduction. The operation was performed four weeks ago and the result has been a perfect one.

**The Part Played by the Strained Muscles and Ligaments in Producing the Aggregated Symptoms and Apparent Increase of Deformity in Coxa Vara.** Borchard,<sup>1</sup> 1897, attributes much to the soft parts, and advises that in all cases the patient should be placed at rest and in extension for a short time; after this one is better able to ascertain the correct amount of deformity due to the curvature of the neck, and can act according to this indication. Borchard thinks that operation is seldom indicated. He calls attention (with cases) to the importance of recognizing the sudden appearance of restricted motion and abnormal function of the limb after a recent trauma in latent cases of coxa vara, when before the injury the patient's attention has not been called to the hip. Borchard does not consider the possibility of a fracture at the epiphysis of the head of the femur as a possible explanation.

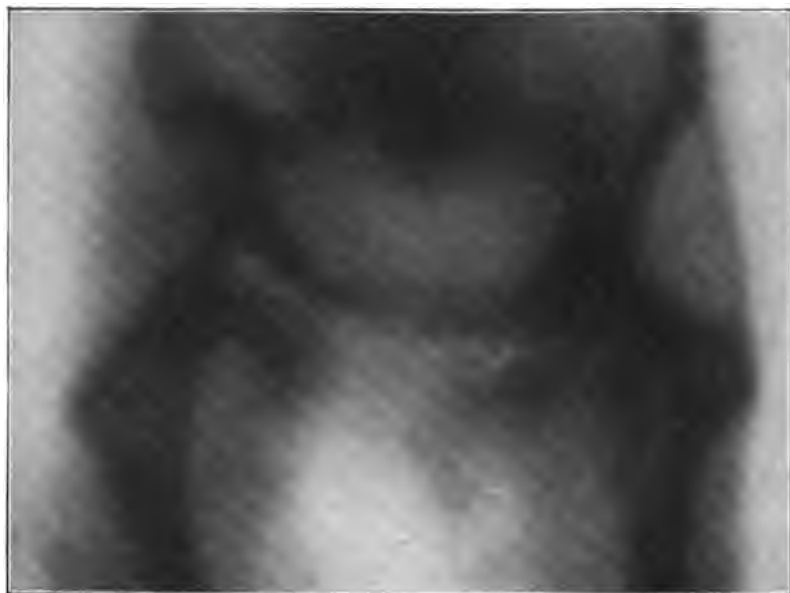
**The Importance of the X-ray Photograph in the Diagnosis of Coxa Vara.** Hofmeister,<sup>2</sup> 1897, discussed this question before the Twenty-sixth German Congress. In seven cases the clinical diagnosis was confirmed by the X-ray. In six cases, in which a differential clinical diagnosis could not be made, the X-ray showed the existence of a neck curvature in three and a normal neck in three. The Röntgen photograph is not only of value in diagnosis, but the clear picture gives an indication for the method of operation. More recently Hofmeister<sup>3</sup> contributes two very exhaustive articles. The first part of the first article and the second article deal entirely with the X-ray photograph, and represent his more extended experience since his paper in 1896. It would be impossible to review this satisfactorily except in too great detail, but everyone interested in X-ray photography and coxa vara should read Hofmeister's most excellent discussion. The diagnostic possibilities of the Röntgen ray are by no means exhausted. One should

<sup>1</sup> Centralblatt für Chirurgie, vol. xxiv.

<sup>2</sup> Beiträge zur klinische Chirurgie, 1898, vol. xxi.

<sup>3</sup> Ibid.

FIG. 44.



Coxa vara dextra. (HOFMEISTER.)

FIG. 45.



Coxa vara sinistra. (HOFMEISTER.)



FIG. 46.



*Coxa vara duplex.* (HOFMEISTER.)

FIG. 47.



*Coxa vara duplex.* (HOFMEISTER.)

be familiar with the photograph shadow of the normal, and should remember that although, as a rule, there are three curves of the neck, only the downward curve is projected. Any change in the position of the pelvis, limb, or in the light produces changes in the projected picture which may lead to diagnostic errors. For this reason the position of the patient and the light should, if possible, be the same; any change should be carefully noted and considered in the interpretation of the photograph. The correct reading of an X-ray photograph, especially of the pelvis and hip-joint, is by no means a simple matter (Figs. 44, 45, 46, and 47).

**Treatment of Coxa Vara.** Hofmeister and the majority of authorities are averse to operative measures. Under proper conservative treatment the majority of cases of coxa vara recover with good functional use of the limb. In cases, especially bilateral, in which the deformity is marked, and in cases in which the restriction of motion is very marked, operative measures are advised, as follows:

1. Subtrochanteric osteotomy. (Hofmeister prefers this to any other method.)
2. Resection of a wedge-shaped piece of bone from the neck of the femur. Krask,<sup>1</sup> 1896.
3. Linear osteotomy of the neck. Budinger,<sup>2</sup> 1896.
4. Resection subtrochanteric. Müller, Kocher.
5. Resection of head and neck, leaving the trochanter with the shaft. Sprengel.

The question of the best operative procedure in coxa vara is not yet settled.

*Note, November 15, 1899.* The result after the resection of the head, Sprengel method, has given a perfect result in my recent cases. The patient is walking without any apparatus, and the deformity is corrected.

<sup>1</sup> Centralblatt für Chirurgie, 1896, Band xxiii. p. 121.

<sup>2</sup> Wiener klinische Wochenschrift, vol. xxiii. p. 1263.

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[NOTE.—See page 158.

I am surprised to read in the most recent text-book on surgery (*International Text-book of Surgery*, Warren and Lovett, 1899, vol. i. p. 40) the following: "The bacillus *aërogenes capsulatus*, as described by Welch and Flexner (*Journal of Experimental Medicine*, 1896, vol. i. No. 1), is an interesting bacterium that may be found at autopsies, but which has not yet been shown to possess pathogenic properties in man." . . . "The bacillus is non-pathogenic."]

# DISEASES OF THE KIDNEYS.

By JOHN ROSE BRADFORD, M.D., F.R.C.P.

## ANOMALIES.

ANOMALIES of the kidneys are of interest to the pathologist, to the clinician, and to the surgeon, for many reasons: to the pathologist, because they not only afford evidence of malformation, errors of development, or the sequelæ of illnesses and lesions in foetal life, but there can be little question but that kidneys anomalous in position or in form are more liable to a variety of diseases than a normal organ, so that to the pathologist they possess not only a pathological but also a direct practical interest. To the clinician and to the surgeon, anomalies of these organs are not only of considerable interest, but of great practical importance, as many errors in diagnosis both in kidney diseases and in other abdominal affections can be traced to the overlooking of some anomalous condition of the kidneys. Thus it has happened more than once that congenital absence or atrophy of one kidney and the enlargement of the opposite kidney (a perfectly normal hypertrophy) has been looked upon as dependent on the presence of an abdominal tumor, and laparotomy has been performed. A still more serious error is that the single enlarged kidney has been removed under the impression of its being a tumor. These afford sufficient examples of the importance of this subject to the surgeon. To the clinician, anomalies in the position of the kidneys may give rise to serious errors in diagnosis, of which the most familiar example is the horseshoe kidney being mistaken for a malignant growth. Among recent contributions to our knowledge of this subject, Dr. Newman's<sup>1</sup> article on "Malformations of the Kidneys" is one of the most complete.

The classification of the varieties of the displacements and malformations of the kidney presents difficulties. Most usually these cases are simply divided into displacements and malformations of the kidney, the latter including the variations in number, variations in size, and variations in the arrangement of the vessels or the ureters. Newman, however, gives a more elaborate classification, dividing displacements without

<sup>1</sup> London Clinical Society's Transactions, 1898.

mobility into the congenital and acquired, the congenital being further divided up into displacements with deformity and displacements without deformity. In one thousand post-mortems investigated by Newman, in twenty-four instances the position of one or both kidneys was abnormal, and in only nine of these was there any malposition of the suprarenal capsule, showing very clearly that anomalies in position may affect one of these organs without the other. Many of the cases that Newman quotes are of interest not only from an anatomical point of view but also on account of their simulation of other diseases. Especially is this so in the case in which the right kidney was situated above Poupart's ligament, causing a fulness in the right iliac fossa and lower lumbar line. The patient suffered from pain in this region, and he was considered to have a perityphlitic abscess. On operation the swelling was seen to be dependent on a displaced kidney, and no cause for the pain was elicited. The kidney was surrounded by a very thick adipose capsule, and it is at least possible that the pain may have been dependent upon temporary congestion from pressure or kinking of the renal vein, with displacement of the organ. This is not uncommonly the cause of the attacks of pain to which patients with floating kidneys are liable. The kidney, as is well known to all who have experimented on this organ, is extraordinarily distensible—the slightest pressure on the renal vein causing extreme distention of the kidney—and it is probable that this may not only be a cause of the attacks of pain of the character just described—namely, where the organ occupies an anomalous position—but it may perhaps be an explanation of some varieties of renal pain in a number of other conditions. Two other cases of displaced kidney are described; in one of these the kidney was displaced downward, lying in front of the iliac crest, so that the upper border of this kidney presented itself at the lowermost part of an incision for lumbar colotomy. In the second case the right kidney was displaced downward and rotated on its axis in such a manner that the ureter left it on its upper surface and entered the upper aspect of the bladder. The kidney was normal in shape and size, and the structures at the hilum were normal, notwithstanding the fact that the pelvis of the kidney looked upward, inward, and forward.

**Congenital Displacements, with Deformity.** In this second group of cases, as Newman and other observers have pointed out, the alteration in the shape of the organ is often dependent on its anomalous position. In a great many of these cases of congenital displacement there are anomalies of other structures, and more especially of the large intestine and peritoneum, and very frequently of the renal vessels.

Many observers have pointed out that in these cases of congenital displacement one kidney only is affected, and the left kidney is more

usually the one affected. Newman agrees with former observers, that the most frequent displacement is one in which the organ lies across the left iliac synchondrosis. In other cases it is displaced lower, so that it lies over the prominence of the sacrum or between the rectum and the bladder, or even in the cavity of the sacrum. When the kidney lies across the brim of the pelvis or in the pelvis the vessels supplying it have an anomalous origin from the aorta. Newman quotes one case in which both kidneys were displaced—in one, the right kidney to the right of the promontory of the sacrum, and in the other, the left kidney to the iliac fossa. This observation is of interest, inasmuch as most observers were of the opinion, as mentioned above, that congenital displacements involved one kidney only.

The ureters in these cases of displacement not uncommonly arise from the anterior surface instead of from the inner.

The main importance of congenital displacement of the kidney is the liability of its being mistaken for an abdominal tumor. Further, in some rare instances they have caused obstruction to labor. I know of one case where, in an operation for imperforate anus, the surgeon felt a mass in the cavity of the sacrum which was nothing but a displaced normal kidney, and very serious results followed its incision.

**Acquired Displacements of the Kidney** belong really to a totally different group, and may depend upon the enlargement of some other organ; occasionally kidneys may be displaced owing to the contraction exercised by cysts in the lower parts of the kidney, and Newman quotes a case, recorded by Morris, where the left kidney was displaced into the brim of the pelvis by the presence of a large cyst in its lower part.

**Malformations of the Kidney.** Malformations are of more interest pathologically than clinically. Newman divided them into variations in number and variations in form and size. This classification, however, is not quite satisfactory, since it is clear that variation in number is usually associated with variation in form and size, for if only one kidney is present it is fairly certain to be hypertrophied.

Theoretically, variations in number may be three: there may be a supernumerary kidney, a single kidney, or both may be absent.

The supernumerary kidney is exceedingly rare, but one case is quoted by Newman in which above the left kidney a small accessory kidney, supplied by a branch of the renal artery and having a distinct ureter, and microscopically having the structure of healthy renal tissue, was found.

Similarly, absence of both kidneys is only of embryological interest, and also as illustrating the fact that life may be maintained *in utero* for a considerable time without any renal tissue. Absence of kidneys is most frequently found in acephalous monsters.

The remaining condition—viz., a single kidney—is one which is of the most importance. As Newman points out, the expression single kidney is liable to confusion if it be made to include such diverse conditions as a single kidney in a normal position, differing only from the normal in its size, and; on the other hand, such a thing as a horseshoe kidney, which is clearly of totally different origin and is rather to be looked upon as an illustration of a fused kidney. Further, a distinction must be drawn between a single kidney dependent on a want of development of the kidney on the opposite side and a condition where the kidney on one side has undergone atrophy, either in foetal life or as a result of disease in childhood. These atrophied kidneys are often extremely small and difficult to find unless a most careful search is made; but cases are seen every now and then where there is complete absence of one kidney and of the vessels and ureter on that side. In these cases the opposite organ is, of course, hypertrophied, and Newman quotes a case in which the hypertrophied organ weighed twelve and a half ounces. It is interesting to observe that in some of these cases the hypertrophied organ really weighs more than the sum of the weights of normal kidneys, and I have seen an instance of this myself. It would seem that in some of these cases, therefore, the hypertrophy is greater in amount than theoretically would be necessary. In this case of Newman's the microscopical examination of the hypertrophied organ showed, in his opinion, that the increase in the size of the kidney was due to an augmentation in the bulk of the glomeruli and to an elongation and increased convolution of the uriniferous tubules rather than to a numerical hyperplasia.

Newman quotes several cases in which the presence of a large kidney on one side was associated with the presence of an atrophied kidney on the other. The weight of this atrophied kidney varies greatly. In some of Newman's cases it weighed as much as half an ounce, or even an ounce. On microscopical examination he states that but little normal renal tissue was found, and that often the organ consisted of nothing but a mass of fibrous fat. In some cases of atrophied kidney which I have observed it has been noticed that although tubules are present, no glomeruli are seen, and this would seem to suggest that in some of these cases the atrophy of the organ is not so much dependent on the existence of some lesion destroying the organ as upon some congenital anomaly of development.

These cases of atrophy are of considerable interest with reference to their cause. It is probable that in most cases atrophy, extreme in character and amount, is dependent either on some disturbance of the circulation in the organ affected or else on obstruction of the ureter. In many cases of atrophy the vessels are found diseased; endarteritis, etc., is common, and it is possible that functional derangements of the circula-

tion, produced, for instance, by contraction, as well as obstruction dependent on endarteritis, may give rise to atrophy of the organ. Obstruction of the ureter is unquestionably a cause of atrophy; it has long been noticed that stones are sometimes found in the pelvis of the kidneys which have undergone atrophy, and it was at one time taught that complete obstruction of the ureter led to atrophy of the kidney, incomplete obstruction causing hydronephrosis. A series of experimental observations carried out in dogs by myself all show that if the ureter be completely obstructed by ligature, even for so short a period as a fortnight, and if then the distended ureter be incised and drained, a very perfect atrophy of the kidney is produced. In all cases, however, the ligature of the ureter is followed by the production of hydronephrosis, and it is only after the relief of this hydronephrosis that the atrophy is produced. It is remarkable that complete obstruction for so short a time should be productive of so extreme an atrophy as that seen experimentally. The kidney in this experimental atrophy regains very perfectly its normal shape, but its size is not more than one-third or even less of the normal. Microscopically the tubules have lost their epithelium in places, and where it is retained the protoplasm of the cells has lost its granules and has become hyaline. The changes in the glomeruli are not so marked.

It is clear from these observations that temporary complete obstruction of the ureter can produce an atrophy very perfect in its characters and closely similar to that seen so frequently in the human subject, and in my opinion it is probable that a great majority of the number of cases of hypertrophy of one kidney, associated with atrophy of the opposite organ, are dependent solely on temporary obstruction of the ureter of the atrophied organ during early life.

The development of this atrophy is not in any way dependent upon the obstruction of the ureter, being followed by the production of a pyonephrosis; it results equally when a simple hydronephrosis has been produced, and the atrophy is a genuine atrophy, apparently dependent upon the effects produced upon the cellular elements of the kidney as a result of the pressure to which they have been exposed, and is not dependent on any inflammatory complication, such as an interstitial nephritis with the subsequent formation of fibrous tissue. The atrophy seen experimentally is not dependent on any overgrowth of fibrous tissue, and so it is probable that where this occurs in the human subject the fibrous tissue is consecutive to the loss of the cellular elements of the kidney, and is not itself the cause of the diminution in the size of the organ. It is very generally held that fibrous tissue in many organs, as, for instance, in the liver, central nervous system, etc., is the *sequel* of a pathological process which has led to the destruction of the higher

elements of the tissue rather than the actual *cause* of the disappearance of these cellular elements.

It would also seem from these observations that the kidney rarely recovers its functions entirely after the ureter has been obstructed completely, even for so short a time as a fortnight.

Obstruction of the ureter in the human subject occasionally leads to different results, since it is well established that complete obstruction of the ureter for as long a period as a week or even ten days may occur without the development of any hydronephrosis or pyonephrosis, the suppression of urine being practically complete. This result is never seen experimentally, according to my experience, and whenever the ureter is obstructed, even as high as the pelvis of the kidney, the invariable result is distention of the urinary channels above the obstruction. That is the one discrepancy between experimental results and the results seen to follow obstruction of the ureter in disease.

A further point of some interest is the development of pyonephrosis. In many experimental cases the ligature of the ureter through the peritoneum is followed by the development of a pyonephrosis, notwithstanding the use of antiseptic measures and the absence of any inflammatory complications in the peritoneum in the vicinity of the ligatured ureter; and at any rate it is possible that in some such cases the infection of the retained urine is dependent on organisms reaching the urine from the kidney—in other words, that it is a descending infection rather than one dependent on contamination from the ligature and the operative procedures. It is well known that the urine in many diseases contains organisms, of which typhoid fever is a striking instance, and it is possible that this condition of bacilluria is more common than is supposed. Experimentally, it certainly can be said that in many cases where all care has been exercised a pyonephrosis has developed instead of a hydronephrosis; but the question of the development of atrophy subsequently to the draining of the distended ureter is in no way greatly influenced by the presence or absence of a pyonephrosis; the most perfect atrophy may ensue after a simple hydronephrosis.

Newman discusses a number of questions in connection with the presence of a single kidney, and among others THE DURATION OF THE LIFE OF THE INDIVIDUAL, as it is a question of some moment to the surgeon whether, if the patient have but one kidney, life is in any way threatened. Newman records the age of death of seventeen patients who had but a single kidney, and in all cases these patients had lived beyond sixty years of age, and two of them survived to over eighty. Thus it would seem that at any rate life can be maintained for long periods with but a single kidney.

Another question of considerable interest is whether hypertrophy of



the kidney can occur with equal readiness at all ages. It certainly can occur during foetal life, as Morris records a case of a well-formed foetus, born at full term, where the right kidney only was present and was twice its normal size. On the other hand, it has long been noticed that in cases of malignant disease of the kidney occurring in adult or elderly patients the opposite kidney was frequently not hypertrophied, and this latter observation would seem to suggest that the kidney does not undergo hypertrophy with equal readiness in advanced life.

A number of observations to test this point were conducted by myself some time ago in dogs, and it may be affirmed that the removal of one kidney in puppies certainly is followed by very great enlargement of the opposite kidney; the same is seen in young dogs. In old dogs, however, of nine or ten years of age and upward, the removal of one kidney is not followed, in my experience, by any appreciable enlargement of its fellow; and it would seem that not only does hypertrophy fail to occur in old animals, but also that the degree of hypertrophy is far greater in the young than in the adult. In many cases in the human subject where one kidney only has been found, it has been noticed, quite apart from the existence of disease in this single organ, that the hypertrophied organ is greater in weight than the sum of the weights of two healthy kidneys. In many cases in the human subject it is difficult to demonstrate this, owing to the fact that such patients frequently develop disease of the single organ, causing an unnatural enlargement, and this probably accounts for the older observations in which where one kidney only was present it was of great size; still, apart from this fallacy, I think it is undoubted that where one kidney only is present in the human subject it is frequently greater in weight than the sum of the weights of the normal kidneys.

In conditions like diabetes mellitus, where there is bilateral hypertrophy, the enlargement is often considerable, and it would seem in those cases where hypertrophy ensues, owing to the abrogation of the function of one kidney, that if the morbid processes occur in the young the production of renal tissue by the economy may be greater than the normal. Some observers, more especially Tuffier,<sup>1</sup> have advanced the view that the removal experimentally of quantities of kidney substance, equal in weight to the total normal kidney weight, is followed by the development of fresh kidney substance, and such observers would correlate the amount of hypertrophy observed with the extent of kidney substance thrown out of action by the lesion produced experimentally or by disease. In a series of observations conducted to test this I was unable to determine that the amount of the hypertrophy was in any way dependent

<sup>1</sup> *Chirurgie du Rein*, Paris, 1890.

on the amount of kidney substance removed. Thus if a portion of one kidney be removed in a dog the operated kidney will undergo a certain amount of atrophy and the opposite kidney a certain amount of hypertrophy ; but it is impossible to correlate the amount of hypertrophy with the amount of kidney removed or with the amount of atrophy. In some cases the removal of a large amount of one kidney was followed by the production of a small amount of hypertrophy of the opposite kidney. In others the removal of a small amount of one kidney led to the production of a very considerable amount of hypertrophy of its fellow. The only factor that seemed to influence the amount of hypertrophy in any constant manner was the age of the animal, a greater hypertrophy being always observed in the younger animal. It would seem, therefore, as if the very large single hypertrophied kidneys occasionally met with in the human subject were to be looked upon as evidence of hypertrophy having taken place during early life.

Newman states that in true compensatory hypertrophy the kidney is found homogeneously enlarged in all its parts, and seldom, if ever, weighs more than two normal kidneys. This, no doubt, is true in the majority of cases ; but still cases are seen, as mentioned above, where the weight is greater than that of the two normal kidneys. Newman also mentions the fact that hypertrophy does not always follow, even when one kidney is undeveloped or functionally useless, and he quotes a number of instances where a single kidney of approximately normal size has been found in these conditions. These observations show how complicated the question is and how the presence or absence or amount of hypertrophy cannot be correlated entirely with the amount of destruction or want of development of renal tissue.

Opinion is still divided on the nature of hypertrophy. Some recent observers, as, for instance, Tuffier, say that after removal of one kidney new renal structure, such as glomeruli and tubules, are formed in the opposite kidney, and Tuffier,<sup>1</sup> in his book on the subject, published a figure which he considers to be evidence of the formation of a new glomerulus. Careful examination of this figure, however, will show that the appearances are to be looked upon as dependent rather on a mass of leucocytes than on the formation of such complicated structures, and certainly experimentally all observations made by myself with reference to this point have failed to reveal any such appearances. In my opinion the enlargement of the kidney seen experimentally is probably dependent rather on an enlargement of the pre-existing glomeruli and tubules, perhaps on an increase in the length of the convolutions of the tubules, and certainly to a great extent on an increased vascularity of

<sup>1</sup> *Études expérimentales sur la Chirurgie du Rein.*

the organ. The kidney, as before mentioned, is a most distensible organ, much more so than is usually thought, and if the appearances of the hypertrophied organ are compared with those of the opposite kidney that has been removed experimentally, it will be seen that the tubules in the hypertrophied organ are separated from one another to a greater degree than they are in the normal, this being dependent on an increased distention of the bloodvessels which run between the tubules; the great enlargement of the organ, in my opinion, is in part dependent on this increased vascularity.

A number of observers, Morris, Mosler and others, have shown that patients with a single kidney are prone to a number of renal disorders, more especially renal calculus, hydronephrosis and pyonephrosis, tubercular disease and chronic nephritis. Newman quotes twelve cases collected by Mosler, in nine of which death was due to calculus in the ureter, and he records eight cases of single kidney in which calculi were present.

Newman considers that in all cases of single kidney the pelvis and ureter are never double, and he looks upon cases of kidney provided with double pelves and double ureters extending to and entering the bladder as examples of fused kidneys rather than as examples of a single kidney. He also quotes a case of hypertrophy of one kidney, the organ weighing ten and three-quarter ounces, where the opposite kidney was normal in weight (six and a half ounces) and both kidneys were typically healthy.

Newman recognized three varieties of fusion of the kidney—one the familiar horseshoe kidney, where the organs are joined together at their lower end. In some cases the horseshoe kidney is really an instance of incomplete fusion, the two kidneys being simply united by an isthmus of fibrous tissue. In others the fusion is more complete, and the organ may be extensively lobulated and the ureters deformed and the bloodvessels anomalous. Exceptionally, in horseshoe kidney, the point of union between the two kidneys is at the upper instead of the lower end of the organ.

The second variety recognized by Newman is that known as the sigmoid kidney, which is usually described under the term of a single kidney, and here the two organs are united end to end. In this case, although the appearances at first sight suggest the existence of a single hypertrophied organ, it may be seen that the condition is really due to an end-to-end fusion of the two organs. The fact that the ureters were normal in appearance, in one case springing from a normal pelvis, and that although both started on one side they opened at the normal points into the bladder, is an argument in favor of this view.

Newman considers that the sigmoid form of kidney is the rarest form of fusion.

The third variety is that known as the disk-shaped kidney, where the fusion of the two organs is very complete, the fused organ occupying one side, with entire absence of the kidney on the opposite side; in the instance quoted by him there were numerous anomalies in vessels, the fused kidney being supplied by three sets of renal arteries and with two ureters normal in their appearance and ultimately opening one on each side of the bladder.

### TOXICITY OF URINE.

The toxicity of urine has attracted less attention of late years than formerly, although it is a question of some importance in relation more especially to the pathology of uræmia.

It has been generally recognized that the urine is toxic, although there is no consistency of opinion among different observers as to which constituents of the urine exert the greatest toxic action.

In many diseases the urine is toxic, owing to the kidneys acting as the channel for the elimination not only of toxins but also for the microbes causing the disease. But the expression "toxicity of the urine" is more especially used in reference to the toxic action of the normal urine or the toxic action of this fluid in other diseases than those associated with the presence of micro-organisms in the body.

In most observations on the toxicity of the urine it has been injected into the circulation of animals with or without the previous ligation of the ureters. Inasmuch as its toxic action is exerted quickly the ligation of the ureters is not absolutely necessary, as the amount of urine secreted during the experiment is usually so small as not to materially vitiate the results of the injection.

Although a great number of observers, from the beginning of the century onward, have carried out observations on the effects of urine injected into the circulation, it was Bouchard's lectures, some ten years ago, that more especially directed attention to the subject. He elaborated the theory of auto-intoxication, which had attracted notice at that time, more especially by the work of Gautier and others. Since Bouchard's work on the subject the most important additions to our knowledge have been contributed by Beck, in 1898, and more recently by Herringham, who has conducted a series of observations on the effects following the injection of normal urine. Bouchard not only made observations with normal urine, but he also studied the effects following the injection of the urines of disease, and more especially the urine secreted in kidney disease. He considered that not only was the normal urine toxic, but that in renal disease, and more especially in uræmia, the urine lost a great deal of its toxicity, and he presumed that the kidneys were

unable, as a result of disease, to excrete the toxic bodies produced by the metabolism of the tissues, and that uræmia might, therefore, be dependent on the retention of these toxic bodies. Bouchard<sup>1</sup> treated the matter in great detail, and considered there was a great variety of toxic substances in the urine, both of inorganic and organic origin.

Many of his results, however, have not been substantiated by later observers, and Herringham's<sup>2</sup> work deals more especially with this question in relation to the normal urine. Whereas Bouchard considered that the salts formed only one of the many toxic substances present in the urine, and that the pigments and extractive matters were also toxic, Herringham is inclined to the belief that practically the whole of the toxicity of the urine is dependent on the salts, and more especially on the potassium salts. At any rate, he believes that the variations in the toxicity of the urine—in health—under different circumstances are entirely dependent on the variations in the amount of potassium salts that are present. In this respect Herringham's views coincide with the views of Feltz and Ritter,<sup>3</sup> who published in 1881 a long series of researches on this subject. They considered that their results showed that the toxicity of the urine was dependent on the mineral salts in it, and especially on the potassium salts; in fact, they were inclined to believe that it depended entirely on this.

This view undoubtedly influenced medical practice for many years, and led many practitioners into withholding the administration of potassium salts to patients suffering from renal disease, inasmuch as it is well recognized that in renal disease there is a delay in the excretion by the kidney of substances introduced into the blood-stream which normally are readily excreted. This delay in excretion is even seen where, as in the granular kidney, the excretion of urinary water is abundant.

Practically all observers are agreed that the most potent nitrogenous constituent of the urine—urea—has but little toxic action, although perhaps in most of the experiments on the subject the quantities of urea injected into the circulation are small compared to the quantities which are found in the blood of patients dying from renal disease.

It is not at all uncommon for the blood of patients dying of acute uræmia to contain twenty or even thirty times the normal amount of urea, which may be taken as 0.015 per cent. In uræmia the percentage may rise to 0.4 per cent., sometimes even to 0.5 per cent., in the blood, and when it is remembered that the same percentage-amount practically is present in the muscular tissues, and that the muscular tissues form approximately half the weight of the body, the quantity of urea that

<sup>1</sup> Translated by Oliver, London, 1896.

<sup>2</sup> *Journal of Pathology and Bacteriology*, August, 1899.

<sup>3</sup> *De l'urémie expérimentale*. Paris, 1881.

is present in the organism under these circumstances is far larger than the quantities which have been used experimentally, and it is doubtful whether these large quantities of urea can be looked upon as entirely innocuous.

Herringham,<sup>1</sup> in his experiments, has shown unquestionably that the toxicity of the normal urine varies *pari passu* with the quantity of potassium salts present, and this has been arrived at by simultaneous determinations of the toxicity, by injection intravenously into rabbits, and of the amount of potassium salts present by chemical analysis.

Although we may readily admit that the toxicity of the normal urine depends on the potassium salts present, it is a long step from this to the view of Feltz and Ritter, that uræmia is generally dependent on potassium-poisoning, although potassium is universally recognized as a relatively powerful toxic substance, and more especially as a cardiac poison.

Many of the symptoms which are seen as a result of the injection of urine, such as drowsiness, muscular twitchings, convulsions, and fall of temperature, are very similar to those that we are familiar with in uræmia. Again, the injection of urine is followed by the production of myosis, which is also a fairly constant phenomenon in uræmia. Thus, unquestionably, many of the phenomena of uræmia resemble those seen to follow the injection of urine into the circulation.

All the symptoms seen to follow the injection of urine experimentally can be produced by the injection of potassium salts, with the exception of myosis, and it is not determined upon what constituent of the urine this phenomenon is dependent.

Herringham failed, as did Beck, to substantiate the more or less elaborate conclusions of Bouchard, such as that the night urine had a toxic action different from the day urine. Further, Herringham has established the point that the pigment of the urine when prepared in a state of purity has apparently no toxic action. This is a point of some interest, as many observers, especially Bouchard, were inclined to look on the pigment as very toxic, and it is, of course, notorious that in many kidney diseases the urine is very destitute of pigment; but little, however, has been as yet established as to the seat of formation of the normal urinary pigment.

The great difficulty in looking upon uræmia as being dependent on the poisoning of the tissues, owing to the retained urine or the retained potassium salts, is that in suppression of urine, even when complete, the phenomena seen are not those of uræmia, or, at any rate, are not those of ordinary acute uræmia; in fact, they differ so much from acute uræmia that very frequently the condition is entirely overlooked.

<sup>1</sup> De l'urémie expérimentale. Paris, 1881.

Formerly it was thought that it was only when the suppression of urine was dependent on obstruction that the phenomena differed from those of uræmia, and so much was this the case that the name of obstructive suppression was given to the clinical picture where the patient remained conscious, with no convulsions and no coma, and with only slight myosis and a few muscular twitchings toward the end. Where the suppression was dependent on other causes, such as the removal of the only kidney present, or obstruction of the circulation, or, in fact, any condition leading to cessation of the activity of the kidneys without there being any obstruction to the ureter, it was thought that acute uræmia of the ordinary type supervened. Certain cases, however, have been described where complete suppression has existed for a week or more from causes such as these, where the symptoms produced have been identical with those seen as a result of calculous obstruction. Hence, it is clear that in the human subject complete suppression of urine, either as a result of obstruction of the ureters or as a result of the sudden abrogation of the functions of kidneys practically healthy, produces identical symptoms. These symptoms are not only identical in the two cases and quite different to those in acute uræmia, but they closely resemble the results seen in the laboratory as following excision of both kidneys. Further, experimental ligature of the ureters or excision of both kidneys, provided antiseptic precautions are taken and the two kidneys are removed at separate operations, with a due interval between them, so as to diminish the severity of the procedure, produces the same result. The only conclusion which can be drawn is that the cessation of the activity of healthy kidneys and the retention, therefore, of the urinary products do not produce the clinical picture of the acute uræmia with which one is familiar in Bright's disease; and this is a serious objection to the view that the mere retention of normal urinary constituents, whether potassium salts or other bodies, can be held accountable for the production of the ordinary forms of acute and chronic uræmia.

### CHLORIDES IN THE URINE OF PNEUMONIA.

Since the middle of the present century it has been known that during acute pneumonia there is a diminution of the amount of chlorides, or even a disappearance of them, from the urine.

In 1875, Fraenkel<sup>1</sup> showed that subsequently to the crisis there was an increased excretion of chlorides; but it was not until 1880 that it was shown, in a paper by Rohmann,<sup>2</sup> that the diminution in the excretion of

<sup>1</sup> *Charité Ann.*, Berlin, 1875, Band ii., S. 320.

<sup>2</sup> *Zeitschrift für klinische Medicine.* Berlin, 1880, Band i., S. 513.

chlorides was due to a temporary retention of these substances in the body.

Hutchison,<sup>1</sup> in a recent paper, deals with the whole question anew, both from a clinical and a pathological stand-point. The results of previous observations had established that the chloride output during an attack of pneumonia is greatly diminished; secondly, that the diminution is dependent on the retention of chlorides in the body, and, thirdly, that after the crisis there is often an increased secretion. According to Hutchison, the points that required further investigation were (1) the degree of diminution in the amount of chlorides excreted; (2) the relation between this diminution and the height of the pyrexia; (3) the question as to whether the extent of lung involved affected in any way the amount of chloride excretion, and (4) the association, if any, of the presence or absence of chlorides with albuminuria. Hutchison bases his conclusion on the results of an investigation of twelve cases of pneumonia. In some cases he found that the chlorides were not only diminished, but were entirely absent from the urine at some period of the disease. There is, however, no relation between the absence or presence of albumin in the urine and this disappearance of the chlorides. In some cases entire absence of chlorides coincided with absence of albumin; in others both chlorides and albumin were present together. Although the chlorides may disappear entirely for a few days, and occasionally during the whole period of the disease, it is more common for the chlorides to be diminished only to such an extent that mere traces are present for at least one or two days. It is rare, according to Hutchison, for the whole excretion throughout the attack to exceed two grammes of chloride of sodium per diem. As regards the relation between the chloride diminution and the pyrexia, the evidence points to the conclusion that there is no relation between the degree of fever present and the chloride diminution, nor can any relationship be detected between this diminution and the extent of lung involved.

The diminution in the excretion lasts usually for one or two days after the crisis, and is succeeded by a sudden and excessive excretion. A comparison between the amount of chlorides in the ingesta and in the excreta shows that there is a true retention of chlorides within the body, and that apparently the amount retained is approximately some two grammes of chloride of sodium per diem for each day of the disease. According to Hutchison, the chlorides are the only constituents of the urine which are diminished in pneumonia. Urea, the phosphates, and the sulphates are increased. Increase in the urea is more obvious than it is in the phosphates, and in these respects Hutchison's observations

<sup>1</sup> Journal of Pathology and Bacteriology, 1898, vol. v., No. 4, p. 406.



correspond with those of other observers. Though the diminution in the amount of chlorides in the urine is such a marked phenomenon of pneumonia, yet it occurs in other acute febrile states, and notably in acute rheumatism and in typhus. Hutchison failed to find any diminution in the excretion in cases of bronchopneumonia, and he is of opinion that the behavior of chlorides in the urine is a help in the diagnosis of cases of pneumonia in which physical signs are either absent or delayed. In malaria the behavior of the chlorides is exceptional, as they are increased in amount during the pyrexia.

**The Diagnostic Value of the Diminution of Chlorides in Pneumonia.** Hutchison remarks, in the first place, that the mere presence of fever does not appear to be associated with any marked reduction in the amount of chlorides in the urine if the restricted diet be taken into account. This is especially true in cases of chronic or prolonged fever, such as typhoid, and other observers are quoted, showing that the excretion of chlorides in typhoid may amount to as much as five grammes per diem; and it is only during the first week of typhoid that there is any appreciable reduction in the amount of the chlorides, and even then the diminution is never so great as to simulate disappearance.

According to Hutchison, a case of high fever, with the chlorides reduced to a mere trace, may be one of typhus fever or acute rheumatism or pneumonia. On the other hand, a case of high fever with chlorides in the urine in fair abundance is certainly not a case of pneumonia, and, to use his words, the test, therefore, is of negative rather than of positive value. He considers that in the diagnosis of croupous pneumonia from other pulmonary diseases the estimation of the urinary chlorides is of great value, as croupous pneumonia is the only pulmonary condition associated with a constant and marked diminution of these salts. Thus in pleurisy and in empyema, he states that the chloride excretion may remain high. There are some other conditions, however, in which the chlorides of the urine may diminish greatly or even disappear, more especially cases of hypersecretion of the gastric juice in cases of gastric dilatation. Finally, the degree to which the chlorides are diminished in a case of pneumonia is apparently no criterion of the severity of the disease, and affords no assistance in forming a prognosis.

As to the cause of the diminution of the chlorides in the urine there has been a great variety of opinion.

The first question that presents itself is whether the chlorides of the food are absorbed normally in cases of pneumonia. This question, however, has been answered by observations of Rohmann, who estimated the amount in the food, comparing it with that in the feces, and showed that sodium chloride was absorbed. A more favorite theory was the existence of a vicarious excretion of chloride, either by the skin or by

the sputum or by the bowel. It has been definitely shown that no such excretion occurs from the bowel, and observations have also proved that the secretion in the sweat is not greater than normal. Many observers have thought that the pneumonic sputum accounted for the diminution of the chlorides in the urine. Hutchison's observations show that although this sputum is rich in chloride of sodium, yet the amount present is quite disproportionate to the quantity retained, and in no case did he find more than 0.3 of a gramme of sodium chloride excreted in a day in the sputum. It is clear, therefore, that the sputum cannot be looked upon as a cause of the retention of these salts. A somewhat similar view has been held by many who say that the chlorides accumulate in the pneumonic exudation. Analyses by Hutchison and others show that the pneumonic exudate contains a very small quantity of sodium chloride; thus the exudate contains about 80 per cent. of water and only 2.4 per cent. of sodium chloride in the dried residue, and Hutchison calculates, partly as a result of his own observations and partly from Terray's observations, that even if the lungs were completely consolidated only from four to eight grammes of sodium chloride would be kept in the exudation, and that inasmuch as in the height of pneumonia two grammes a day are readily retained, it is evident that one must look elsewhere for the cause of the disappearance of the chlorides, for it cannot be due to the pouring out of an inflammatory exudation rich in sodium chloride. Hutchison draws attention to the fact that the percentage amount of sodium chloride in the sputum is far higher than that present in the exudation, and he hazards the opinion that the sputum in pneumonia is not derived directly from the inflammatory exudation. The small percentage of chlorides present in the pneumonic exudation explains also the fact that the degree of the diminution of the chlorides is not commensurate with the extent of lung involved.

It has been also asserted that the chlorides are retained in pneumonia owing to the loss of power on the part of the kidney to excrete these bodies. There is no doubt that the kidneys are often affected in cases of pneumonia. This explanation is very untenable, since it would not account for the fact that the chlorides are not so greatly diminished in other febrile states. Further, in cases of acute nephritis where the excretory power of the kidney is, of course, seriously interfered with chlorides may be excreted abundantly.

It is only when the nephritis is such as to cause suppression that the chloride excretion greatly diminishes. Further observation shows that the chlorides do not accumulate in the blood, but, on the other hand, that they do accumulate in the tissues. It may be that the increased metabolism in the tissues, necessitated by fever, requires the presence of an increased amount of chlorides, and this, on the whole, is the most satis

factory explanation, although it still leaves untouched the fundamental question as to why the febrile process in pneumonia should be so characterized by this diminution, more especially as in the pyrexia artificially produced by the injection of the pneumococcus no such retention of chlorides has been demonstrated.

### URÆMIA.

The two most pressing problems in relation to uræmia at the present time are, first, its relation to the different varieties of renal disease, and, second, its nature. Speaking broadly, the views held with reference to the nature of uræmia are divisible into two main groups: those in which the symptoms are referred to a more or less mechanical cause and those in which the cause is sought for in some toxic substance present in the economy.

Of late years what may be called the mechanical theory of uræmia has not met with many supporters—that is to say, the theory which regarded the symptoms of uræmia as produced by alterations in the cerebral circulation, leading either to constriction of certain vascular areas of the brain or else to œdema.

This view of Traube was really mainly based on the experimental fact that the ligature of the carotids and the anæmia of the brain produced thereby was a mode of producing convulsions and epileptiform seizures similar to those met with in certain forms of uræmia. There can be no question that interference with the cerebral circulation to such an extent as that effected by ligature of the carotids is an efficient cause for the production of epileptiform seizures. It was thought, inasmuch as high tension is a common phenomenon in renal disease, that the cerebral vessels, like those of the body at large, were constricted, and that in this way the anæmia necessary for the production of epileptiform seizures might be produced. Further, it was held that just as the high tension of renal disease is sometimes present without any gross material changes in the walls of the bloodvessels, and is, therefore, in these cases presumably due to spasm of the muscular coat produced either indirectly through the vasomotor system or directly by the action of some toxic substance circulating in the blood, so the anæmia producing epileptiform seizures might be a temporary condition dependent upon a functional spasm of the cerebral bloodvessels, or in more chronic and persistent cases might be due to permanent narrowing of the vessels dependent on changes in their walls. The supposed narrowing of the cerebral vessels, however, whether functional or of structural origin, was always correlated with a high tension of the pulse; in other words, it was thought that the state of the cerebral vessels, and, therefore, the

cerebral circulation, could be gauged by the state of the peripheral vessels. In the high tension of renal disease it is obvious that we have not only to deal with a hypertrophied heart, but also with an increased peripheral resistance, although pathologists may not agree as to which is the primary condition; most, however, look on the cardiac hypertrophy as a phenomenon that is produced secondarily to the primary increase in the peripheral resistance. Others, nevertheless, regard the thickening and narrowing of the peripheral vessels as a secondary change following an increased blood-pressure dependent on the primary hypertrophy of the heart, and this cardiac hypertrophy as brought about by the direct action on the heart muscle of some urinary constituent, such as urea, present in the blood in excessive amount. It is immaterial, from the point of view of the mechanical origin of uræmia, which of these two views is correct, the main fact being that once high tension is established in renal disease both cardiac hypertrophy and increased peripheral resistance dependent on thickening of the vessels are present. As mentioned above, also, many pathologists have gauged the state of the cerebral vessels from considerations of the state of the peripheral vessels of the body at large.

This mechanical view of uræmic convulsions, as dependent on the cerebral anæmia or cerebral œdema, is not only acceptable because cerebral anæmia can be proved to be a cause of convulsions, but also because this view affords a ready means of explanation of the more or less localized seizures that are sometimes seen in uræmia. A localized anæmia or a localized œdema affords a ready explanation of an epileptiform seizure limited to one side of the body or even to one limb, and such localized seizures, as every clinician knows, are not at all uncommon in uræmia. However, the recent work by Leonard Hill,<sup>1</sup> on the *Intracranial Circulation*, completely alters one's views with reference to the dependence of the cerebral circulation on that of the body at large. Physiologists have long known that although nerves could be demonstrated on the vessels of the pia mater, yet there was no experimental evidence in favor of the existence of cerebral vasoconstrictor nerves, notwithstanding the fact that the cerebral vessels possess a well-developed muscular coat. Hill's observations, however, show that in reality the cerebral circulation is regulated in what may be called a secondary manner by changes in the visceral circulation. All conditions in which the blood-pressure is raised by increasing the peripheral resistance produce dilatation of the cerebral vessels, as Roy and Sherrington showed before. It is impossible, by acting on the vessels of the body at large, either by excitation of the vasomotor centre or by the action

<sup>1</sup> The Physiology and Pathology of the Cerebral Circulation. London, 1896.

of drugs which cause constriction, to produce constriction of the cerebral vessels. In other words, even if the agent employed is one that is capable of causing cerebral constriction, the general vascular constriction produced simultaneously raises the blood to such an extent that the cerebral vessels are passively dilated by the increased blood-pressure produced by the general visceral constriction. This is a fact which has not, perhaps, attracted the attention it deserves from pathologists—viz., that when increased tension is produced by increasing the peripheral resistance the bloodvessels of different parts of the body are affected to different degrees, so that it may come about that an agent which causes constriction of bloodvessels of the visceral areas may lead to dilatation of the vessels of other areas, not owing to any difference in the action on the two different sets of vessels, but owing to the fact that the constriction in the one case is more powerful, due to a better development of the muscular coat or a more copious innervation of the vasoconstrictor nerves; and the heightened tension so produced overpowers the constriction in the areas where either the muscular coat of the bloodvessels or the innervation from the vasomotor centre is less well developed. Conversely, constriction of the cerebral vessels is produced passively by dilatation of the vessels of the visceral and other areas.

These physiological facts are not only of importance in relation to the mechanical theory of uræmia, but also are of supreme importance in understanding more thoroughly the mechanism of cerebral hemorrhage in renal disease. The fact remains, therefore, that the mere existence of high tension in renal disease, with or without arterial changes, such as endarteritis, etc., is not to be looked upon as proof that a state of cerebral anæmia exists. Although when chronic renal disease has existed for some time, and wide-spread arterial degeneration, such as endarteritis, is present, it is possible that the cerebral circulation may be seriously interfered with.

The main conclusion to which we wish attention to be drawn here is that even if in renal disease there is some agent present which is capable of causing heightened tension dependent on vasomotor constriction, such a condition would tend to be accompanied rather by cerebral congestion than by cerebral anæmia.

Constriction of the cerebral vessels producing diminished blood-supply is, however, the only cause we are acquainted with as one capable of producing convulsions; and inasmuch as heightened arterial tension tends to produce cerebral congestion rather than cerebral anæmia, the view that uræmia is dependent solely on the alterations in the calibre of the cerebral vessels to a great extent falls to the ground, as to accept it would necessitate not only the hypothesis that the cerebral vessels could

be acted on independently of those of the body at large, but, furthermore, it would be impossible to account for the fact that these uræmic manifestations are so common in conditions of high tension, since we have seen that if the cerebral circulation be affected at all in conditions of high tension, congestion rather than anæmia would be produced.

Apart from these general conditions two other arguments in favor of uræmia being dependent on vascular changes have been advanced, and these are, first, that localized uræmic seizures are not uncommon, and, secondly, the attacks are often of extreme suddenness.

Neither of these arguments, however, is really of much value, since many poisons are well known to have a localized action, even when circulating in the body at large, and, secondly, it is well known that the great group of poisons defined as having a cumulative action may produce their effects with great suddenness. Neither of these two arguments in favor of the mechanical theory as against the toxic theory of uræmia are of much avail.

Uræmia is probably indirectly associated in some way with high tension, and more especially with some varieties of high tension. Uræmia is not particularly associated with that form of kidney disease which is known as the true granular or raspberry kidney, although in this condition high tension, cardiac hypertrophy, and arterial degeneration are all present, often to a high degree, and are more or less characteristic of the disease. Uræmia is much more closely associated with the small, contracted white or mixed kidney, where the lesion, especially in its naked-eye features, is quite different from that seen with the true granular kidney. With the small, contracted white kidney high tension is often a prominent feature, and when present cardiac hypertrophy and arterial changes are well marked. It is remarkable, however, that extreme cases of contracted white kidney may exist with little or no cardiac hypertrophy, and this even where the contracted white kidney shows great diminution in the area of the cortex, and where, after stripping the capsule, an exceedingly granular surface is left. This is the more constant condition; exceptionally, however, small white kidneys are seen where, after stripping the capsule, a comparatively or even perfectly smooth surface is left; this, again, is very exceptional, and it is probable that the origin and natural history of these different forms of white kidney are different. Although high tension is seen with all its accompaniments—cardiac and arterial—both in cases of granular kidney and in those of contracted white kidney, cerebral hemorrhage is far more common in the former and uræmia in the latter. It is true that occasionally uræmia is seen in cases of the true granular kidney and cerebral hemorrhage in cases of the contracted white kidney, but, speaking broadly, the former statement is the more correct. Further,

the contracted white kidney is much more often seen in young patients and the true granular kidney in the middle-aged or elderly. It is a well-known fact that uræmia, especially acute uræmia, is more often seen in young patients suffering with renal disease than in those of more mature years.

Although uræmia may occur, and does occur, in all forms of renal disease, yet the more severe manifestations of this condition (especially those described as acute and fulminating uræmia) are, in my opinion, more especially associated with the contracted white kidney. This is certainly true if the uræmia of chronic renal disease only is under consideration; but, of course, acute renal diseases of various kinds are necessarily common causes of acute fulminating uræmia.

If the mechanical theory of uræmia be rejected there remain only the toxic theories, and, speaking broadly, the toxic theories may be divided as follows: (1) That the toxic body is the product of the normal metabolism of the body, and is not excreted, owing to the deficient activity of the renal structures; or (2) that the toxic body is one that is formed in the tissues, owing to an altered and deranged metabolism; or (3) that the toxic body or bodies are dependent on the activity of micro-organisms or even of abnormal digestive processes. In the case of the second and third of these theories, retention of these bodies in the blood-stream may also clearly play a part, since the toxic bodies formed either in the tissues or introduced might, under conditions of normal activity of the kidneys, be freely eliminated; but owing to the impaired efficiency of these organs as filters, it might be that they are retained, and thus the body is poisoned. The main arguments in support of the third theory are the proneness of the tissues of patients suffering from renal disease to suffer from secondary inflammatory complications, and also the well-known fact that even when uræmia itself is present secondary inflammations, such as pericarditis, pneumonia, pleurisy, etc., are not uncommon. Further, the occurrence of an inflammatory complication in such patients may determine an attack of uræmia. These are the facts in support of the view that the toxic condition may supervene as a result of the invasion of the tissues of the patients by microbes. This view, however, is very unsatisfactory, as although there are many forms of uræmia, yet they are all of them very characteristic and quite unlike the toxæmias we are familiar with as a result of microbic infection. It is possible that the alimentary canal may play an important part in the production of uræmia, as it is unquestionable that severe uræmic manifestations have sometimes been observed as a result of indiscretions in diet, and more especially, perhaps, as a result of a patient eating food that was not perfectly fresh; here the damaged excretory organs are unable to deal with sufficient

rapidity with the toxic bodies introduced. Further, the fact that in some cases of granular kidney albumosuria is present may be used as an argument that in renal disease there is some derangement of the digestive and absorptive processes. Without accepting the view that uræmia is dependent on auto-intoxication of intestinal origin, there can be little doubt that patients with renal disease may run great risks from the taking of decomposed or partially decomposed foods.

The simplest explanation of uræmia undoubtedly is one which would record the phenomena as dependent on the retention of one or all of the normal urinary constituents, and although authorities would be unable to agree upon which of the urinary constituents is the prime toxic agent, yet there has always been a general consensus of opinion toward this view. The difficulties in the way of accepting this theory lie, in the first place, in the fact that no substance has been isolated from the urine which is capable of causing all the phenomena characteristic of uræmia, and, secondly and more important, that in the human subject complete suppression of urine does not produce the clinical picture characteristic of acute uræmia. This is a fact which seems of importance in the pathology of uræmia, and one, perhaps, that has not attracted all the attention it deserves. If with complete suppression of the urinary functions the symptoms produced are quite distinctive and different from those of acute or chronic uræmia, it seems difficult to believe that acute uræmia can be dependent on the simple retention of normal urinary constituents. It has long been known that in the cases of obstruction of the ureter of the only available kidney the symptoms are quite distinct, and consist mainly in weakness, contraction of the pupil, and fall of temperature. In addition to these, the constant symptoms, slight vomiting, and occasional twitching of the voluntary muscles, and even slight œdema, may be seen. These symptoms may persist for a week or ten days, the patient remaining conscious, and fits, delirium, coma, dyspnoea, in fact all the more characteristic features of uræmia, are conspicuous by their absence.

The clinical picture of calculous suppression is so characteristic as to merit a distinct term, such as that of latent uræmia. Formerly it was thought that although these symptoms were seen in cases of calculous and other obstructions of the ureter, yet when the suppression was caused by a lesion involving the kidney structure itself, acute uræmia was produced, and not what has been described above as latent uræmia; in other words, that latent uræmia was characteristic of obstructed ureters where the circulation through the kidney was still more or less efficiently carried on; but that when the morbid process destroyed the kidney structure itself, as, for instance, in acute nephritis, or, more rarely, where the only kidney present has been removed, or where fatal reflex suppression has occurred



without mechanical obstruction to the ureters, acute or some variety of true uræmia supervened. These facts have led some observers to think that the symptoms were different according as to whether the kidneys remained with their circulation more or less intact, but their secretory powers annulled, or whether the lesion was such that not only were the excretory powers annulled, but that circulation also was arrested. These facts gave some color to the view that the kidney might possess an internal secretion, and that the arrest of this internal secretion was the cause of uræmia, or, at any rate, of some varieties of uræmia. This view gained so much support, especially in France, that for some time uræmia was treated by the injection of kidney extracts—a mode of procedure which has not been followed by any material benefit. Some observers have also thought that the blood obtained from the renal vein of animals—*e. g.*, the goat—contained substances capable of exercising a beneficial influence in uræmia.

In the laboratory the removal of the kidneys in animals, or the arrest of their function by ligature of both ureters, produces a series of symptoms not only indistinguishable from one another in the two cases, but closely resembling also those seen in the human subject as a result of calculi or other conditions causing complete suppression.

Experimentally, it is impossible to distinguish between the effects produced by simultaneous double ligature of the ureters and those seen after double extirpation performed in two stages, or double ligature of the renal arteries. Further, more conclusive evidence still has been afforded by the fact that complete necrosis of the cortex of both kidneys dependent on thrombosis of the renal arterioles produced in the human subject<sup>1</sup> not acute uræmia but the same set of symptoms as those seen in cases of complete calculous suppression. In this patient the cortex of both kidneys was entirely necrotic, and life was maintained for a week without the excretion of any urine. During life the case was indistinguishable from one of complete calculous obstruction.

We arrive at the conclusion, then, that both in animals and in man a complete and sudden cessation of the functions of more or less healthy kidneys, when produced by such a cause as double calculous obstruction or by such a condition as that just mentioned leading to necrosis of the entire cortex, produces a set of symptoms not only resembling each other but also resembling those seen in animals after removal of the kidneys. In all these cases the symptoms are those described as belonging to latent uræmia. Inasmuch as in all these conditions the normal constituents of the urine are retained in the blood and tissues, it is difficult to think that uræmia, acute or chronic, and especially the dyspnœa, the coma,

<sup>1</sup> Journal of Pathology and Bacteriology, vol. v., No. 2, p. 195.

and the convulsions, can be due to the retention of any normal constituents in the urine.

If uræmia is not dependent on the retention of the normal constituents of the urine the question arises as to whether in the conditions in which uræmia arises there may not be the production and possibly the retention of some abnormal substance. The source of such a toxic body might be sought for in the metabolism of the tissues, since many forms of renal disease, more especially chronic renal disease, are characterized by great wasting. In certain renal diseases, such as granular kidney, wasting may not only be as prominent a symptom as it is in malignant disease, but may also be the symptom for which the patient first seeks medical advice. In many forms of renal disease, where great wasting is present, it is overlooked or mistaken, owing to the anasarca, and is only evident with the subsidence or relief of this. Doubtless the emaciation in renal disease is partly dependent on the imperfect digestion, the nausea, the vomiting, and the diarrhœa, which are prominent features in many forms of kidney disease; still, it may be present to an extreme extent in cases of contracted kidney without the symptoms of digestive insufficiency being very marked.

Further, it has been shown experimentally<sup>1</sup> that removal of large quantities of kidney tissue, such as the half of one kidney and the whole of the other, is followed by great emaciation and by the excretion of large quantities of urine containing increased amounts of urea. Animals with a fraction of one kidney approximating a quarter of the original total kidney weight excrete an abundant dilute urine, containing large quantities of urea, considerably in excess of the normal output, and they may excrete during periods of starvation quantities of urea as great as those previously excreted on a full diet. The source of this increased secretion of urea can only be in the disintegration of the tissues, and, perhaps, more especially of the muscular tissues. The condition produced experimentally is characterized by great weakness as well as by great wasting. Inasmuch as the quantities of urine and urea excreted are greater than those seen in health, these phenomena cannot be dependent on poisoning by the retention of any normal constituent of the urine, and a series of observations have shown that the tissue wasting and the excretion of urea are definitely correlated with the amount of kidney substance which is left after the mutilation.

Further, if both kidneys are removed experimentally in animals the amount of urea and other nitrogenous extractives present in the blood and tissues is greater than can be accounted for by simple retention. This

<sup>1</sup> The Effects Following Partial Nephrectomy. *Journal of Physiology*, 1899, vol. xxiii., No. 6, p. 415.

can be arrived at by considerations such as the following: If a known amount of urea is excreted on a known diet, and then both kidneys are removed and during the few days of life no food is eaten, it is evident that if no increased production of urea occurs in the tissues the amount of urea retained in the body ought to be less than the sum of the amounts that would have been excreted on the previous diet. As a matter of fact, the quantities of urea that can be found in the blood and tissues after double nephrectomy on the third day are greater than the theoretical amounts that should have been retained. Hence, it is evident that an increased production of these bodies must have occurred, and even in so short a period as three days after double nephrectomy the waste and weakness are quite obvious.

It would seem, therefore, that great diminution in the amount of available renal tissue is followed by a disintegration of the tissues with an overproduction of urea and other nitrogenous bodies. And this would seem to point to the conclusion that the renal tissue has some other function than that of simply excreting the materials which are brought to it by the blood. If this view is correct, it allows of the possibility of uræmia being dependent not so much on the retention of normal urinary constituents as on the abnormal production of other bodies of an unknown character, the source of these being the tissue disintegration.

The experimental facts alluded to above, as showing that the diminution in the amount of available kidney substance is followed by tissue disintegration and the excretion of large amounts of urinary water and urea, are fully discussed in a paper of mine in the *Journal of Physiology*, 1899.

Clinically, many cases of acute uræmia are seen where, even during the period when uræmic symptoms are prominent, the patients pass considerable quantities of urine and urea. Acute uræmia is by no means necessarily accompanied by complete suppression, even when the uræmia is very acute and severe. This is more especially true of the acute uræmia that is seen in chronic contracted kidneys. In acute nephritis, and in chronic Bright's disease associated with much dropsy, suppression more or less severe is often seen.

Many of these facts would seem at first sight to point to the conclusion that the kidneys possess an internal secretion, and that the cessation of this internal secretion is followed by the disintegration of the tissues and the possible formation of toxic bodies. The great difficulty in the way of accepting this view of uræmia lies in the fact that neither in the human subject nor experimentally does acute uræmia follow on the removal of all kidney tissue. As mentioned above, under these circumstances latent uræmia—not acute uræmia—is seen; so that at the

present it seems that one cannot go further than to say that acute uræmia is more especially seen as a terminal phenomenon in cases of chronic renal disease, such as the contracted white kidney, and that no explanation of uræmia would be satisfactory which does not take into consideration the great tissue disintegration, which can be recognized both experimentally and clinically to follow diminution in the available kidney tissue.

Although acute uræmia is so frequently seen in those cases of chronic renal disease without the existence of any high degree of suppression, yet, of course, acute uræmia is often seen in cases of acute renal disease where suppression, often complete, is present. But there the problem is more complicated. At present one would sum up the position by saying that complete suppression occurring with calculous obstruction, or with complete and sudden arrest of the circulation of the kidneys, more or less healthy up to the time of the vascular occlusion, in both cases is characterized by the supervention of the characteristic symptoms of latent uræmia. Secondly, that acute uræmia, with coma, delirium, convulsions, dyspnœa, and all the classical features, is not seen under these circumstances, but is seen as a terminal phenomenon in cases of chronic renal disease, and more especially is this so with the contracted white kidney; and that under these circumstances there may be comparatively little suppression, the patient passing quantities of urine and urea which are quite considerable when the scanty diet and the severe vomiting are taken into consideration. Although the latent uræmia of the first group of cases may be dependent on the retention of the normal constituents of the urine, it is probable that the uræmia of the second group of cases is of more complex origin, and that here, at any rate, the tissue disintegration with the overproduction of nitrogenous substance, which can be proved to take place experimentally, is a factor in its production.

Undoubtedly this view of uræmia will not be satisfactorily established until the toxic bodies or body have been isolated, and this at present has not been done. Further, in cases of chronic renal disease with dropsy, where there is a certain amount of suppression, and in cases of uræmia with acute nephritis, where there may be complete suppression, the problem is still more complicated. It must always be remembered that the same substance in different doses may produce different symptoms; but for the many reasons mentioned above it is probable that all varieties of uræmia, at any rate, cannot be regarded as dependent upon simple retention of a single normal urinary constituent.

# PHYSIOLOGY.

By ALBERT P. BRUBAKER, M.D.

PHYSIOLOGICAL investigation has continued unabated during the past year. The results of these investigations have been recorded for the most part in physiological journals, and relate to all departments of the subject. The number of titles approximates 500, the number of pages 10,000. In the limited space devoted to physiological progress in this review, it is not possible to select more than a few papers the conclusions of which appear to have a direct reference to the problems of clinical medicine. How far these conclusions will stand the test of future criticisms it is impossible at present to state. Physiological mechanisms are extremely complex, the means employed for investigation liable to interfere with their normal activity, and the results which are obtained liable to misinterpretation. Hence, some degree of uncertainty attaches itself to the results of many published researches, which renders it difficult to make positive statements as to their validity.

## METABOLISM.

**On the Structure of Cell Protoplasm.** One of the most important subjects in histology, and one capable of exercising considerable influence on physiology and pathology, is the question of the composition of cell protoplasm and how much of the structure usually observed in it is artificial and due to post-mortem changes and the action of the reagents employed in preparing it for examination. In a paper showing extensive study, Hardy<sup>1</sup> details some of the more interesting facts as to the nature of the changes taking place under the action of fixatives by comparing fixation of known homogeneous substances with that of cells. So far the workers in this field, opened up by the researches of Flemming, are few and scattered, making Hardy's results, even when only confirmatory, interesting. His investigations led to the following:

The very essence of the process of fixation is the separation of solid from liquid, and the formation thereby of a structure which may have had no counterpart whatever before the fixation occurred. A study of the action of reagents upon the colloidal matter shows that when an

<sup>1</sup> Journal of Physiology, 1899, vol. xxiv. p. 158.

insoluble modification is formed there is a separation of solid particles, which are large, molecular aggregates, and that these become linked together, to form a comparatively coarse, solid framework, having the form of an open net, which holds fluid in its meshes.

In cases where the reagent is partially miscible with the colloidal mixture this framework is modified in degree, but remains the same in kind. If, for instance, gelatin of medium concentration be fixed by alcohol or corrosive sublimate it takes the form of a continuous solid, hollowed out by vesicles of about  $7\mu$  in diameter, which, as a rule, become deformed to polyhedra by mutual pressure, but if it is fixed by formalin an open net is produced.

The study of fixing reagents upon a pre-existent net of insoluble colloid demonstrated that this net was not markedly altered. The meshes were distinctly smaller, but the figure was otherwise unchanged.

As in homogeneous colloidal material, structure is brought out by fixatives due to coagulation, so also the structure of dead matter which was once living may be referred to the coagulation phenomena of death and to post-mortem change; and it is to be inferred that the structure seen in cells after fixation is due to an unknown extent to the action of the fixing agents.

If a considerable proportion of insoluble matter is separated by the process of dissolution a continuous framework is formed; if only a small quantity is separated a granular deposit will result. Corrosive sublimate is especially a fixative that brings about coarse changes toward the formation of structure.

The appearance of structure in a cell may also be due to the presence of or to post-mortem changes in secretion masses. The cells of glands, for instance, hold (1) cell substance, (2) secretion masses in "secretion vacuoles," and "it is very possible that the cell protoplasm between the secretion vacuoles is pressed out into thin masses, and that they become the same as, or equivalent to, the threads in cells of other kinds" (Flemming).

Langley was able to demonstrate this to be true in the cells of mucous salivary glands, and Hardy's study on the alveolar cells of the orbital glands of young mammals appears to prove that the typical net of the mucous secretory cell is the optical or actual section of the honeycombed cell protoplasm, distended by the swelling of the secretory granules, and that it is not a net within (as has been asserted as possible), but a net composed of the whole of the cell protoplasm.

The interpretation of structure, therefore, as seen in fixed and fresh cell substance, may be reduced to three propositions:

1. That a regular geometrical figure may be conferred on the cell protoplasm by the presence in it of secretion masses, and especially by post-mortem swelling of secretion masses.

2. That, so far as can be judged by control experiments with colloid masses of known character, the radical changes in the physical characters of the cell substance produced by fixation are of such a nature as necessarily to produce a structure.

3. That the process of dying without fixation, since it appears to consist in all cases of a coagulation of some part of the cell substance, must also produce structure not present in full life.

From many observations on certain gland cells and cells of red marrow, of frog's lymph, and of the intestine of the wood-louse, the conclusion is reached that cell protoplasm reacts to corrosive sublimate and osmic vapor in the same way as does a soluble colloid to a reagent which converts it into an insoluble colloid; and that therefore there is no evidence that the structure discoverable in the cell substance of these cells, after fixation, has any counterpart in the cell when living, and a large part of it is an artifact.

**The Metabolism of the Nucleins.** Instead of looking at the influence of nucleins on the excretion of uric acid alone, Milroy and Malcolm<sup>1</sup> made a study of their general metabolism in health and in disease, especially leucocythæmia. They came to the following conclusions:

The digestion products of nuclein-holding tissues, nuclein and nucleic acid, cause, on being absorbed, a temporary leucocytosis, which is accompanied by a rise in the  $P_2O_5$  excretion above that derivable from the absorbed phosphorus. These alterations are especially well marked after giving nucleic acid. The alloxuric bodies are excreted in excess after nucleic acid has been given, and in all probability also after large doses of nuclein-holding tissues or nucleins, although in their experiments, owing to the small amount of thymus taken, there was no distinct increase. The uric acid excretion after administration of nucleic acid was only slightly, if at all, increased; but the amount of nucleic acid administered was small, on account of disagreeable symptoms manifested after large doses.

In contradistinction to nuclein and nucleic acid, metaphosphoric acid caused no leucocytosis, no increase in the excretion of  $P_2O_5$  or alloxuric bodies. In the case, then, of nuclein and nucleic acid the increase in the leucocytosis is in all probability the primary factor leading to the increase in the  $P_2O_5$  excretion—that is to say, subsequently to or accompanying the hyperleucocytosis there is a leucolysis. The average amount of  $P_2O_5$  excreted in the urine, in the one case of leucocythæmia examined, was 0.915 gramme, while under normal conditions (in a normal man) the average excretion was 4.038 grammes. Now, when one remembers that the average number of leucocytes in the normal case was 8000, in

<sup>1</sup> Journal of Physiology, 1898, vol. xxiii.

the leucocythæmic case 330,000, if the amount of  $P_2O_5$  is any gauge of the nuclear breaking down, one is compelled to admit that in the latter case the leucolysis is diminished. Beside this diminution in  $P_2O_5$  there was an increase in the alloxuric nitrogen in the leucocythæmic case, both the bases and uric acid apparently participating in this increase. All this would seem to indicate that in leucocythæmia the developmental history of leucocytes is different from that under normal conditions.

The different signification of different forms of pathological leucocytosis was brought out by a case of plumbism. In this the conditions are comparable to those existing normally, the leucocytes being merely altered in number and not with regard to the relative proportions of the different varieties; and, as was to be expected, there was no variance in amounts of  $P_2O_5$ , or in the ratio between  $P_2O_5$  and nitrogen, or in the amount of alloxuric excretion from a normal leucocytosis.

**On the Relation of Uric Acid Excretion to Diet.** Seeking the causal relationship of the excretion of uric acid to diet, Hopkins and Hope<sup>1</sup> carried out a series of experiments on seven adult males which confirm the statement of Mares, ten years ago, and other observers since then, that during the period of increased nitrogen excretion which follows a meal the increase of uric acid has a briefer duration than the increase of urea, and occurs characteristically in the earlier hours of the hyperexcretory period. The tests were made after a meal fully isolated, so as to avoid any interference from the remains of the nitrogenous tide due to previous food ingestion. The test-meal was taken at 1 P.M., after complete abstinence from 7 P.M. the preceding day.

In these experiments the uric acid maximum was generally found at the third or fourth hour after the meal, that of the urea showing little regularity of incidence, though generally occurring later. This fact is difficult to reconcile with the view that the uric acid takes origin from the nucleins of the diet, upon which the earlier stages of digestion have only a minimal influence.

On account of the postprandial leucocytosis and uric acid increase frequently occurring together, the hypothesis has been forwarded that the uric acid takes its origin from the leucocytes; but this has been disproved in the past by the test-meals of egg-white, which bring about a leucocytosis, but no uric acid increase. Hopkins and Hope used for a test-meal, to disprove the same, a gruel made of arrow-root, butter, and sugar.

The chief evidence for the view that nucleins play a predominant rôle as uric acid precursors, is based upon the result of thymus feeding, though it has been noted that when pure nucleins have been adminis-

<sup>1</sup> Journal of Physiology, 1898, vol. xxiii.



tered the results have been by no means convincing. To see if thymus gland with the nucleins eliminated would have the same effect, Hopkins and Hope submitted the glands to artificial gastric digestion and administered the filtered extracts as test-meals. They claim that these did produce an abundant and rapid increase of uric acid.

They acknowledge such an experiment to be by no means conclusive, since there is a question whether or not nuclein is taken up in this artificial digestion. But the weight of authority seems to be on their side—namely, that such digestion has no effect on the nucleins, and chemical tests of the filtered extracts employed revealed no nuclein. They therefore suggest that of the total quantity of uric acid normally excreted, that portion which bears a more immediate relation to food does not arise from nucleins, but from some more soluble constituent of the diet, acting either as a direct precursor or as a factor in a synthetic process.

**Some Remarks on the Excretion of Uric Acid and its Relation to Solubility.** Haig,<sup>1</sup> who has been insisting for some time that the excretion of uric acid is almost entirely a question of solubility, maintains, in contradiction of the older observers who found that the administration of uric acid by the mouth led merely to an increase of urea in the urine, that if alkalies or salicylates are given at the same time, to ensure that the urates remain in solution in the blood, the uric acid given is eliminated as uric acid, and that the rise in the excretion of urea is merely due to a decrease in the alkalinity of the blood, which stimulates metabolism. In relation to tea and coffee diminishing the excretion of uric acid, as stated by Bain and Edgecomb, he insists that they omitted the conditions which proved to him the contrary—namely, the simultaneous ingestion of alkalies or salicylates, in order to keep the uric acid in solution. He criticises their work generally, on account of the length of time over which the different experiments extended. A week, he contends, is too short a period to obtain a result of any value, on account of the constantly occurring fluctuations in excretion.

**The Physiological Action of Certain Mineral Waters and Baths on the Blood and on the Excretion of Urea and Uric Acid.** In a series of experiments on themselves, Bain and Edgecomb<sup>2</sup> studied the physiological action of certain mineral waters on the blood and on the excretion of urea and uric acid. The waters employed were those of Harrowgate, which fall into two general classes—saline sulphur (“old sulphur water,” “mild Montpellier,” and “magnesia”) and saline iron (“Kissingen” and “chloride of iron”).

<sup>1</sup> Journal of Physiology, 1899, vol. xxiv., No. 2.

<sup>2</sup> Ibid., vol. xxiii., No. 6.

Old sulphur water caused a fall of "worth" in the red corpuscles which they thought was to be attributed to the effect of the sulphur compound in the water. On urea and uric acid the result was a gradual diminution in the amount of the latter eliminated and a slight increase in the former.

Mild Montpellier sulphur water acted on the blood like the previous water, but to a slightly less extent. A diminished elimination of uric acid occurred, with practically no change in the urea.

Magnesia water effected merely a dilution of the blood, no change taking place in the worth of the corpuscle, though the hæmoglobin and volume of the corpuscle both fell in equal proportion. Uric acid was very slightly diminished, and the urea remained unchanged.

In a control experiment with plain water, to ascertain the effect of the actual fluid ingested, the uric acid was found to be slightly diminished—to about the same extent as occurred with the magnesia water.

Kissingen water showed no effect on the blood, the value of the corpuscle remaining stationary. A slight diminution of uric acid occurred, about equal to that resulting from magnesia or plain water. The urea was raised.

Chloride of iron water caused a rise in the worth of the corpuscle. Uric acid was markedly diminished; urea markedly increased.

As a contrast to the mineral waters, the effect of tea and coffee was tried. The uric acid alone was tested. It was found that both beverages in excess diminished its amount, and on complete cessation there was an immediate rise in the amount of uric acid eliminated.

The summary of the results on uric acid is, in a word, that all the waters, plain water included, caused a diminution in amount, though to varying degrees, and, as has been affirmed by other observers, the amount decreased as the quantity of urine increased.

As to the relationship between leucocytes and uric acid, there was found an inverse variation between the daily number of the former and the daily excretion of the latter.

**The Influence of Saline Solutions upon the Volume of Animal Cells.** The fact that red blood-corpuscles in saline solutions, which possess a concentration greater or less than their native blood plasma, undergo changes in volume, has led Hamburger<sup>1</sup> to carry out a series of experiments under similar conditions with other animal cells, especially white blood-corpuscles and the spermatozoa of frogs. The results of these experiments he regards as of great value for the modern theory of osmotic pressure. This theory, taken in connection with the theory of electrolytic dissociation, in his judgment will clear up many obscure

<sup>1</sup> Archiv für Physiologie, 1898, Heft 4.

points in physiology and pathology, especially in connection with the process of absorption. In the course of these experiments he has observed that not only the red but also the white corpuscles and spermatozoa shrivel in hyperisotonic and swell in hypisotonic solution ; but as the amount of the shrivelling and swelling are less than they would be if the cells consisted of a homogeneous mass, he concludes that these cells must consist of two constituents—a protoplasmic framework and an intracellular fluid—the latter of which alone causes the phenomena of swelling and shrinking. The protoplasmic framework possesses no power of attracting water.

The percentage relation of the protoplasmic framework and the contained fluid was obtained from the quantitative estimation of the changes in volume under the influence of sodium chloride solutions of different concentrations—*e. g.*, if the volume of the whole cell is taken at 100, then the volume of the framework is—

	Per cent. of the entire cell volume.
In the leucocytes of the horse . . . . .	53.0 to 56.7
“ erythrocytes of the horse . . . . .	53.3 to 56
“ “ “ rabbit . . . . .	48.7 to 51
“ “ “ hen . . . . .	52.4 to 57.7
“ “ “ frog . . . . .	72.0 to 76.4
“ spermatozoa (immature) . . . . .	73.2 to 79.4
“ “ (mature) . . . . .	71.6 to 72.8

**The Physiological Effects of Alkalies and Acids in Extreme Dilution.** Jacques Loeb<sup>1</sup> shows by experiments on ciliated infusoria and other lower organisms that alkalies ( $\frac{1}{1000}$  to  $\frac{1}{500}$  normal NaHO solution, or  $\frac{1}{1200}$  per cent. to  $\frac{1}{1600}$  per cent.) decidedly hasten the process of oxidation in animal tissues, and thus act as stimulants to their activity, while diluted acids have the opposite effect. He thinks the addition of small quantities of alkali would increase the beneficial effect of saline transfusions, and asks whether it would not be advisable to give alkalies in fevers to counteract the decrease in alkalinity of the blood.

**The Development of Fat in the Animal Organism under the Influence of Phosphorus.** It is well known that animals which have been poisoned by phosphorus present an apparent fatty degeneration of the liver, kidneys, heart, etc., these organs containing an amount of fat far in excess of that normally present. The origin of this fat and the mechanism of its production have for a long time been subjects of patient investigation. The discussion of the facts observed in phosphorus poisoning has revolved around two points: (1) As to whether phosphorus causes a new development of fat, and, (2) if so, what is the substance from which it is developed. Up to the year 1883 it was generally

<sup>1</sup> Pfüger's Archiv f. d. ges. Physiologie, 1898, Heft 9.

believed that the fat in the various organs originated in a transformation of either the proteids or glycogen. In that year Lebedeff propounded his view, based on many experiments, that the increase in the percentage of fat in these organs was due merely to a transference of fat from regions of the body in which it had previously been stored, although his experiments did not preclude the possibility of fat formation.

With a view of elucidating these problems, J. Athanasiu<sup>1</sup> conducted a series of experiments on frogs, the object of which was to determine not only the increase of fat in individual organs, but the total amount of fat in the body as a whole under the influence of phosphorus, and to compare the results thus obtained with the results of analyses of the bodies of normal frogs of the same weight and kept under the same conditions. The animals were given a poisonous dose, from which they died or were killed in from one to six days. The body was then examined by improved methods, not only for total fat, but for nitrogen and glycogen. As the result of many experiments, Athanasiu concludes that phosphorus does not give rise to increased fat formation, but merely causes a migration to the liver, kidney, etc., of fat previously stored in the body, inasmuch as there was no increase in the total fat above that found in the control animals. These experiments substantiate Lebedeff's view as to fat migration, but in addition eliminate the idea of fat formation. These analyses also showed that there is in phosphorus-poisoning a diminution in the total amount of glycogen, and especially in that of the liver, from which it almost entirely disappears.

### DIGESTION—ABSORPTION.

**The Physiological Consequences of Gastro-enterostomy.** The formation of a fistulous communication between the intestine and the stomach in pyloric obstruction, as in the ordinary operation of gastro-enterostomy, should not theoretically be followed by serious disturbances of digestion. The phenomena observed in human beings in whom this operation has been performed have been extremely contradictory, owing possibly to the character of the pyloric disease. For this reason Siegfried Rosenberg<sup>2</sup> performed the operation on three dogs, with a view of determining the influence of the communication on the digestion and absorption. He found that the operation was followed by disturbances of the entire digestive process, which partly related to the elaboration of food and partly to vomiting. With regard to the first point, he found a deficit in the digestion as well as the absorption of nitrogenous,

<sup>1</sup> Pflüger's Archiv, Band 74, S. 511.

<sup>2</sup> Archiv f. d. ges. Physiologie, 1898, Heft 9.

fatty, and carbohydrate food, which he attributes to the changed relations of the digestive fluids to one another. With regard to the second point, the inclination to frequent vomiting, he excludes the causes usually assigned—namely, a reflux of bile and intestinal juice into the stomach, and attributes it to an antiperistaltic movement of the intestine, by which the intestinal contents are brought into the stomach and act as an irritant. The investigations of Grützner with the Röntgen rays have shown that when mercury is introduced into the intestine it undergoes two movements—a forward and a backward movement—in consequence of what is termed an anastaltic and a catastaltic contraction wave. It is this latter movement which becomes exaggerated in gastro-enterostomy which gives rise to the vomiting.

**The Digestion of Milk.** The duration of the time during which milk remains in the stomach and the conditions which favor its passage into the intestine must be a matter of interest to the practising physician. Reichmann states, from examinations of the stomach contents with a sound, that raw milk leaves the stomach later than boiled milk. Einhorn finds in children that milk diluted with barley water remained in the stomach for one hour and fifty minutes.

Raudnitz<sup>1</sup> tries to solve the question experimentally. From a number of experiments made on cats he arrives at the following conclusions: Diluted milk leaves the stomach more rapidly than natural milk. Of two samples of milk having the same percentage of fat, the sample which contains the least amount of nitrogenous matter leaves the stomach the sooner. The absorption of milk from the small intestine does not take place in the same ratio as it escapes from the stomach. The evacuation of milk from the stomach is not hastened by the addition of sodium chloride.

**Diastatic Action of Pancreatic Juice.** Chittenden, Langley, Eves and others have given us much valuable information on the diastatic action of saliva as modified by various conditions, and in the absence of similar experimental work on the pancreatic juice, we have for the most part been forced to formulate our knowledge of the action of amyllopsin from the experimental work done with ptyalin and other diastatic ferments. Though the inferences drawn by this comparison were probably justified, in order to remove from them the stigma of inference and place them under the domain of fact, Rachford<sup>2</sup> experimented on pancreatic juice itself. He found that a small quantity of free hydrochloric acid had little or no retarding influence on its diastatic action, though larger quantities very materially delayed it.

<sup>1</sup> Englemann, *Archiv f. Physiologie*, 1899, Heft 1.

<sup>2</sup> *American Journal of Physiology*, 1899, vol. ii.

Acid proteids in small quantities slightly increase its diastatic action, and therefore neutral proteids acting in the presence of free hydrochloric acid will neutralize the retarding action of the latter, and by the formation of acid albumin can even assist the diastatic action.

Bile slightly expedites the diastatic action, and not only neutralizes the retarding influence of the free hydrochloric acid, but in the presence of the latter hastens still more the process.

Sodium carbonate has a very destructive influence on the diastatic action, but bile diminishes this influence considerably. He finally adds that bile itself has some diastatic power.

**Absorption of Fats after Ligation of the Biliary and Pancreatic Ducts.** Cunningham,<sup>1</sup> in a series of experiments on dogs, found that after ligation of the biliary and pancreatic ducts absorption of fat, at least in small amounts, did occur. The experiments were carried out with unemulsified vegetable oils—namely, cotton-seed and olive oil. His conclusions are: Although the presence of the bile and pancreatic juice doubtless facilitates the absorption of the fat by the intestinal epithelial cells, their absence from the intestine does not prevent the cells from ultimately absorbing the fat, apparently by a process that is indistinguishable from that occurring in the normal state. The rate of the absorption is much slower, and undoubtedly the quantity absorbed is very much less than in the normal state. At least some of the emulsification under the abnormal experimental conditions was apparently due to the succus entericus.

**The Absorption and Excretion of Iron in the Intestinal Canal.** The question as to whether inorganic iron can be absorbed from the intestinal canal, contrary to the view of Bunge and his followers, who maintain that only iron organically combined with the nucleins of the food can be so absorbed, has again been experimentally studied by Swirski.<sup>2</sup> After feeding guinea-pigs with liquor ferri sesquichlorati and the soluble saccharated oxide of iron, prepared by Schering, for some days, the animals were killed and the tissues of the alimentary canal and of the body generally were examined by microchemical methods and the results compared with results obtained by the same methods on the tissues of animals fed only on normal foods. As the outcome of many experiments, Swirski felt justified in stating that the ingested iron was absorbed by the epithelial cells of the villi and by the interepithelial spaces, and found its way into the bloodvessels of the stroma of the villi as well as into the interglandular tissue of the cæcum. After entering the blood-current, where it forms a constituent of the plasma, it is taken up by the phagocytes and carried direct to the liver.

<sup>1</sup> Journal of Physiology, 1898, vol. xxiii.

<sup>2</sup> Pflüger's Archiv, Band 74, S. 466.

Another portion of the absorbed iron is transferred from the stroma in loose combination to the central lymphatic vessel of the villus, from which it passes into the thoracic duct, and finally into the blood. There was no evidence, however, that iron-bearing leucocytes entered the lymphatic vessel. Swirski was able to demonstrate that there was a quantitative difference in the amount of iron absorbed in animals fed with iron and those fed on normal foods in favor of the former. With reference to the excretion of iron, he did not succeed in normal animals in demonstrating an emigration of iron-bearing leucocytes through the epithelium of the intestinal canal, though numerous small round-cells were found in the lumen of the canal, which, however, gave no iron reaction. In the iron-fed animals there was undoubted evidence of the excretion of iron in the upper and lower portions of the large intestines, which was accomplished by iron-holding leucocytes of small size. Swirski believes with Teichmüller, that there is also an excretion of iron on the surface of the mucous membrane of the respiratory tract.

**The Result of Division of the Splanchnic Nerve.** In an interesting paper Vogt<sup>1</sup> calls attention to the functional disturbances which have been attributed to extirpation of the celiac plexus or division of the splanchnic nerve, and especially of the want of agreement among them. For example, the following effects have been recorded by various observers: An accumulation of alkaline fluids in the intestine; hyperæmia of the intestine; diarrhoea in consequence of the watery transudation, the latter occasionally mixed with blood and mucus; glycosuria, acetonuria. According to Vogt, many, if not all, of these effects are to be attributed to complicating pathological conditions due to the operation. With a view of determining the physiological relations of the splanchnic through the observation of the results which follow its section, he divided the nerve in rabbits and cats in accordance with modern surgical procedure. Most of the animals died after a few days from peritonitis. Two rabbits survived the operation, and lived for weeks and months. Two cats, in one of which there was a unilateral and in the other a bilateral division of the nerve, recovered from the operation entirely. These animals recovered their appetite and began to eat in twenty-four hours. The quantity of food consumed after a few days was as usual; there was no diminution of body-weight nor increase in the quantity of urine excreted daily; the feces of the rabbits was soft, but never fluid. One cat had for several days diarrhoeal discharges. Though the urine of all the animals was examined regularly for sugar and acetone, the examinations gave negative results. If these experiments are to be relied upon it cannot be said that we know anything as to the physiology of this nerve.

<sup>1</sup> Englemann, *Archiv f. Physiologie*, 1898, Heft 5.

**BLOOD—CIRCULATION—RESPIRATION.**

**Researches upon the Amount of Hæmoglobin and the Number of Red and White Blood-corpuscles.** In an essay given the first prize by the medical faculty of the University of Goettingen, Wilhelm Schwinge<sup>1</sup> gives the results of his researches as to the amount of hæmoglobin and the number of the red and white corpuscles under physiological conditions in the different decades of life. He sums up his investigations as follows :

In the different decades of human life the amount of hæmoglobin and the number of the red and white corpuscles are normally very variable. The first two values—*i. e.*, the amount of hæmoglobin and the number of red corpuscles—which are greatest immediately after birth soon sink to a minimum, but increase again with the growth of the body. During the period of maturity these values show certain periodic oscillations, to finally decrease again toward the end of life. The number of leucocytes, however, decreases from the period of growth to that of maturity, but increases again later. There also, in this respect, exist differences in the sexes. During puberty the numbers for the female are smaller than those for the male, but approach each other again at the climacteric period. While for the explanation of this sexual difference he has resource to the differences in the rate of metabolism—he believes that the differences in the amount of hæmoglobin and the number of red corpuscles in the different decades of life are to be regarded as due essentially to differences in concentration and not to real differences in amounts. The differences in concentration are caused by differences in the exchange of fluids between blood and tissues. The large number of leucocytes in youth is probably to be referred to an especially active formation of these elements.

**The Co-ordination of the Ventricles.** The admirable synchronism of the contractions of the two ventricles of the heart has led most observers at once to the opinion that the unison must be enforced by some master mechanism, such as a group of ganglion cells. But two years ago Porter<sup>2</sup> demonstrated that the mammalian ventricles, when cut entirely away from the auricles (where the nervous mechanism seemed to lie), or when cut into pieces, continued to beat if fed with blood through the arteries supplying them. He concluded, therefore, that the co-ordination mechanism, whatever it might be, was present in all parts of the ventricle. He continues his experiments,<sup>3</sup> and advances further by demonstrating that the apical halves of the ventricle (dog)

<sup>1</sup> Archiv f. d. ges. Physiologie, 1898, Heft 7.

<sup>2</sup> Journal of Experimental Medicine, 1897, vol. ii.

<sup>3</sup> American Journal of Physiology, 1899, vol. ii.



beat synchronously when perfused with blood through the coronary artery; thus their synchronism is not dependent on nerve-cells. A very small bridge of muscular tissue suffices to carry the excitation wave from one part of the ventricle to neighboring parts; it is therefore highly probable that their synchronism is maintained through muscular and not through nervous connections. If the right ventricle is separated entirely from the left, but the connections of both with the auricles are allowed to remain undisturbed, the synchronism of the ventricles will be lost; hence, the synchronism of the ventricular contractions is not a function of the auricles, but is managed by the ventricles themselves.

**Infarction in the Heart; Anatomy and Physiology of the Coronary Arteries.** To determine the part played by the coronary arteries from an anatomical, physiological, and pathological stand-point, Baumgarten<sup>1</sup> made a series of observations on cats and dogs after the production of infarcts in these arteries. He found that (1) contrary to general opinion, though in accord with the best authorities, the coronary arteries are terminal, at least in the sense that their anastomoses are so small as to rarely permit the formation of a collateral circulation; (2) their physiological distribution, obtained by the methods of infarcts, corresponds in the main with the distribution outlined by anatomical methods; (3) the part of the heart-wall rendered anæmic by the interruption of its arterial blood-supply may remain contractile at least eleven hours after the ligation of the artery.

**The Physiological Poisons of the Heart.** Dr. E. v. Cyon<sup>2</sup> defines the physiological poisons of the heart as those substances which are normally produced in the living organism, the function of which is to influence the activity of the cardiac and vasomotor mechanism to maintain and regulate their tonus, and gives as illustrations the active principle of the thyroid gland, of the hypophysis, and of the suprarenal bodies. In this communication he reports a large number of experiments which were made with the view of comparing the action of these poisons on the nervous mechanism of the heart and vascular apparatus, with the action of atropine, nicotine, muscarine, and chloral. In a former communication he had established the fact that iodothyryn, the active principle of the thyroid body, is a powerful stimulant to the vagus and depressor nerves of the heart; he had demonstrated, for example, that in the rabbit an intravenous injection of 2 cm. of iodothyryn, containing 1.8 mg. of iodine, again stimulated to renewed activity the vagi and depressors which had been previously paralyzed by the intravenous

<sup>1</sup> American Journal of Physiology, 1899, vol. ii.

<sup>2</sup> Pflüger's Archiv, 1898, Heft 1.

injection of sodium iodide or 1.054 gramme of iodine. In the present communication Cyon presents another series of experiments which shows conclusively that iodothyron possesses the power also to re-establish almost instantly the inhibitory influence of the vagi on the heart after it has been removed by the intravenous injection of atropine. It would appear from these experiments that there is a distinctly physiological antagonism between these two poisons. A corresponding antagonism was shown to exist between iodothyron, nicotine, and muscarine. From the results of his earlier and later experiments, Cyon concludes that iodothyron antagonizes and removes the paralyzing influences on the vagus and depressors of the heart which occur during strumous diseases and after thyroidectomy, even when their irritability has been completely abolished, and that it is also powerful enough to remove the effects of such absolute poisons of the vagus as atropine and nicotine. He thinks there is scarcely a doubt that iodothyron is the most important of the physiological heart-poisons, the function of which is to maintain and regulate the nervous mechanism of the heart, and at the same time antagonize and remove the influence of poisons arising within or introduced from without, which tend to impair the irritability of this mechanism.

**The Physiological Effects of Extracts of the Hypophysis Cerebri.** Among the so-called physiological heart-poisons is included by Cyon the active principles of the hypophysis or pituitary body. Several years ago Cyon published<sup>1</sup> a brief report of some experiments made with the extract of this body in its entirety, which went to show that when injected intravenously it caused an increase in the strength of the heart-beat, with decrease in frequency and an increase in arterial pressure. Attention was also called later to the fact that this extract antagonized the action of atropine on the vagus terminals in a manner not unlike iodothyron.

As is well known, the hypophysis consists of two lobes—viz., an anterior, a glandular structure derived embryologically from the epithelium of the mouth, and a posterior, connected by a stalk with the infundibulum. The posterior lobe contains nerve-cells, neuroglia tissue, and glandular-like epithelial cells, arranged in the form of tubes or closed vesicles, some of which contain colloidal matter (Berkley). With a view of isolating the physiological action of these two lobes, Howell<sup>2</sup> made extracts of the posterior lobe (sheep) more particularly, to which he gave the name infundibular body. When extracts of this body alone were injected into the vessels of a dog the effects produced were slowing of

<sup>1</sup> Pfüger's Archiv f. d. ges. Physiologie, Band 70.

<sup>2</sup> Journal of Experimental Medicine, 1898, vol. iii., No. 2.

the heart-beat with increase of the blood-pressure. If the injections were made after the division of the vagi, or after they were brought under the influence of atropine, there was a prolonged rise in blood-pressure, with a slower and stronger beat. These effects, however, were not of long duration, and the experimenter conjectures, therefore, that the active principle is neutralized or destroyed promptly in the body. An extract of the anterior lobe or hypophysis cerebri alone had, in Howell's hands, no action on either the circulation or respiration.

From further investigation, E. v. Cyon<sup>1</sup> comes to the conclusion that the hypophysis contains two active substances, one of which, called by him hypophysin, slows and strengthens the heart-beats, while the other increases the blood-pressure by stimulating the vasomotor system. Electrical and mechanical stimulation of the hypophysis produced the same effects. Cyon therefore concludes that this organ must be regarded as a protective organ of the brain, in virtue of its power of constricting the small arteries, thus protecting the brain from undue pressure.

In a third communication E. v. Cyon<sup>2</sup> finally concludes, with regard to the function of the hypophysis and the thyroid gland, that both organs have the special purpose of protecting the brain against dangerous congestions and of regulating the flow of blood within the cavity of the skull. Both fulfil their physiological purpose in a *mechanical* as well as in a *chemical* way. The mechanical rôle of the vascular thyroid he compares to a sluice, the opening of which leads off an excess of blood in the brain, thus preventing congestion. The hypophysis, which from its position and construction seems especially adapted to be influenced by oscillations of pressure in the skull cavity, is enabled in emergencies to apply for relief to the protecting influence of the thyroid. It serves principally as a regulator of the blood-pressure in the brain. The chemical or secretory products of these glands, iodothyron and hypophysin, assist the mechanical rôle of these glands by influencing, in virtue of their manifold actions on the vasomotor and cardiac nerves, their functions in different ways. Cyon also reports here the excellent results he has obtained in the treatment of acromegaly in a boy twelve years old. He gave, twice daily, 20 cg. of powdered hypophysis, and believes that his theoretical conclusions are confirmed in every way by his clinical experience.

**Relation of Blood and Inorganic Salts to the Automaticity of the Heart-beat.** Howell and Green,<sup>3</sup> in two papers, took up the question of heart-automatism as influenced by different constituents of the blood. Their investigations confirm the epoch-making work of Merunowicz,

<sup>1</sup> Archiv f. d. ges. Physiologie, 1898, Heft 7.

<sup>2</sup> Ibid., Heft 10.

<sup>3</sup> American Journal of Physiology, 1898, vol. ii.

and more especially Ringer, the latter of whom was the first to show the specific influence of calcium salts on the heart's contractility. Though Howell and Green note their results in different papers, both series of experiments were carried out on muscular strips from the heart of the terrapin, and may be summarized as follows :

A bath of normal serum will not keep a strip in contraction, although it keeps it in good condition for contraction for three or four days. By slightly increasing the amount of calcium chloride in the serum regular contractions may be produced. An artificial mixture of sodium, potassium, and calcium salts, in the proportion in which they exist in serum, acts like normal serum, but regular contractions are produced on increase of the calcium chloride. Since, in such preparations, there is no mechanical obstacle to the complete removal of blood from the substance of the strip, the result renders improbable the theory advocated by Kronecker, that the cardiac tissue beats only as long as serum-albumin is supplied to it by the blood.

Sodium chloride will produce and sustain contractions for a short time only, and the series of contractions presents the appearance of fatigue. This appearance of fatigue indicates only the removal of the inorganic salts necessary to contraction, and is not an exhaustion of the contractile substance of the muscle. Calcium salts in isotonic solutions of sodium chloride stimulate the cardiac strips to increased rhythm and final permanent contracture. Potassium chloride in isotonic solutions of sodium chloride prevents contraction and keeps the ventricular strip in a state of relaxation. There is an optimum ratio of the potassium, calcium, and sodium salts in isotonic solution most favorable to the development and maintenance of the contractions in the muscular strips.

**Carbonic Acid as a Respiratory Stimulus.** In 1896, Benedicenti, at the suggestion of Rosenthal, attacked the view first established by Traube, that the stimulus to respiratory activity is the presence of carbon dioxide, and postulated the view once again, that it is the want of oxygen which is the only cause of respiration and dyspnoea. His experiments were somewhat incomplete, as they included no respiratory phenomena other than those of dyspnoea.

Kropeit<sup>1</sup> has reinvestigated this question, with reference not only to dyspnoea but to other phenomena, such as blood-pressure, papillary reaction, etc., which usually accompany it. It was found in all his experiments that when animals inhaled CO<sub>2</sub> with the normal percentage of oxygen a true dyspnoea arose, characterized by increased depth of respiration, an involvement of all the accessory respiratory muscles, increase of arterial blood-pressure, slowing of the pulse-rate by central irritation

<sup>1</sup> Archiv f. d. ges. Physiologie, 1898, Heft 10.

of the vagus, and dilatation of the pupil. He admits, however, that a want of oxygen may also give rise to dyspnœa.

**The Fate of Carbon Monoxide in the Animal Body.** By a series of experiments as to the fate of carbon monoxide in the animal body, Wachholtz<sup>1</sup> has again demonstrated, as others before him, that after its dissociation from the blood-corpuscles the greatest part is ultimately destroyed, and conjectures that it is converted into carbon dioxide, and that only a small portion is eliminated with the respiratory air—only so much, indeed, as is demanded by the tension of the carbon monoxide in the CO-hæmoglobin toward the air in the alveoli in the lungs. The reinvestigation of this question was necessitated by the statements of Gréhant, that all the CO was eliminated and not destroyed, contrary to the experiments of others. Wachholtz also attempted to experimentally determine the question as to the seat of this destruction, whether in the blood (St. Martin, Pokrowsky) or in the tissues. Basing his experiments on the fact that CO can be driven from its hæmoglobin connection by NO, blood containing CO was shaken for a long time with NO, after which the gas-mixture was freed by appropriate chemical means from the excess of NO. The gas was then conducted to a flask, in the top of which was placed blotting-paper saturated with platinum chloride, which in the presence of CO assumed a brown-black color. In all his experiments this reaction was observed, which was regarded as a proof that the CO was not destroyed by the blood. This fact, taken in connection with the fact that insects are not poisoned by this gas, owing to the absence of hæmoglobin, and that they undoubtedly destroy the gas, led Wachholtz to the conclusion that its destruction was effected in the tissue cells. Though the end-product is in all probability carbon dioxide, this fact has not yet been positively established.

## GLANDS.

**Partial Nephrectomy and the Influence of the Kidney on Metabolism.** In quite an elaborate paper, free of detail, Bradford<sup>2</sup> gives the results on the remaining kidney substance and on the general metabolism of partial nephrectomy in dogs. In the majority of cases (thirty-three) a portion of one kidney was removed, and the whole of the second kidney at a subsequent operation. He reached the following general conclusions :

1. Excision of two-thirds of the total kidney weight is not followed by death, but after excision of three-quarters or more prolonged survival

<sup>1</sup> Archiv f. d. ges. Physiologie, 1899, Band lxxiv., Heft 4.

<sup>2</sup> Journal of Physiology, 1899, vol. xxiii., No. 6.

is impossible, death occurring in from one to six weeks, usually of asthenia.

2. The excision of a portion of the kidney is followed by an increase in the amount of water in the urine, and the larger the excised portion the greater the increase in urinary water. But up to certain limits, approximately three-quarters of the total kidney weight, excision produces no increase in the amount of solid constituents in the urine; after this point there is a marked increase in the amount of urea excreted.

3. The fragment of kidney left is quite able to excrete amounts of urea far larger than those usually excreted, as shown by giving the animals considerable quantities of an exclusively meat diet. A concentrated urine, however, is not passed, the increased output of urea being effected by an enormous increase in the amount of urine.

4. There is a considerable increase in the amount of nitrogenous extractives in the blood and tissues, particularly in the muscles, after excision of large portions of the kidney weight. This increase is not only seen when there is no diminution in the excretion of nitrogen, but also when the nitrogen output is increased. The accumulation in the muscles of these extractives is greater than can be accounted for by the mere retention of the products of a normal metabolism, and it is offered as a suggestion, that when the amount of available kidney structure is greatly reduced, the tissues of the body, especially the muscles, rapidly break down and liberate urea.

5. Division of the renal plexus on one side, with subsequent excision of the opposite kidney, was not found to produce any marked change either in the general economy or in the amount or nature of the urine.

**Chemistry and Action of the Thyroid Gland.** Hutchinson<sup>1</sup> summarizes the results of his observations on the chemistry and action of the thyroid gland as follows:

1. The percentage of iodine contained in the colloid matter of thyroids varies very considerably, but on the average amounts to 0.309 per cent. of the dried substance.

2. On digesting the colloid matter only, those products are active which contain iodine, and the degree of activity of each is roughly proportional to the amount of iodine present. Yet iodized nucleo-albumin, prepared artificially from the thymus, possesses none of the activity of the colloid matter, and if the proportion of iodine in the colloid matter be artificially increased to even ten times the normal amount, its activity is not thereby increased.

3. Intravenous injection of a solution of the colloid material has no effect on the blood-pressure or heart, the fall of blood-pressure which

<sup>1</sup> Journal of Physiology, 1898, vol. xxiii.

results from the injection of thyroid extract being apparently due to one or more of the organic extractives present, and to a less degree to the presence of mineral salts, possibly salts of potassium.

4. Previous removal of the ovaries or testes has no influence upon the results of thyroidectomy, and ovarian feeding has no curative influence in myxœdema; and though it is possible, as recent work seems to show, that the acute symptoms of thyroidectomy are due not to removal of the thyroid proper but of the parathyroids, parathyroid feeding has no effect on myxœdema.

5. Of twenty-four consecutive cases of complete removal of the thyroid only four of the animals survived (16.6 per cent.). This percentage can be raised by thyroid feeding, but only to a small extent. The procedure of keeping the animals warm after the thyroidectomy does not delay the onset of the acute symptoms or modify their course.

6. The presence of a poison in the bile or central nervous system of animals suffering from the result of thyroidectomy could not be demonstrated.

**On Secretory Nerves to the Suprarenal Capsules.** After corroborating Cybulski's discovery, that blood flowing from the adrenal vein contains the substance found previously in extracts of the gland, Dreyer<sup>1</sup> determined the influence of stimulation of the peripheral end of the splanchnic nerve on the rate of formation and discharge of the active substance by comparing the effect on the blood-pressure and heart-beat of the injection into a second animal of adrenal blood drawn respectively before and during splanchnic stimulation. It appears that the amount of active adrenal substance in the adrenal blood is increased by splanchnic stimulation.

**The Reflex Mechanism of the Bladder.** In an instructive paper Dr. Alfons Hanc<sup>2</sup> analyzes the motor factors concerned in the evacuation of the bladder which are called forth in response to stimulation of sensory nerves. From an analysis of the results of his experiments, he draws the conclusion, from the relation between the outflow of urine and the bladder-pressure, that the former cannot be dependent on the latter, but that it depends on the extent to which the sphincter is opened. In proportion to the extent of sphincter opening, the bladder-pressure remaining the same, will be the outflow of urine. These experiments of Hanc confirm the view of von Zeisel, that the contraction of the detrusor does not represent the mechanical cause for the opening of the sphincter, but that each of these factors must be considered in reference to their intensity to different innervations. In other words, the detrusor

<sup>1</sup> American Journal of Physiology, 1899, vol. ii.

<sup>2</sup> Archiv f. d. ges. Physiologie, 1898, Heft 10.

contraction, with its increasing bladder-pressure, as well as the sphincter opening, are functions of different nerve-mechanism. The old view, that the emptying of the bladder is dependent on the contraction of the bladder, is therefore no longer tenable. In these experiments the animals were curarized, to prevent reflex contraction of the abdominal and other muscles; the bladder was filled before each observation with the same quantity of lukewarm water; the strength of the faradic current was in all experiments the same, and it was applied directly to the ischiatic nerve. In a second section of this communication Hanc details the results of the action of various drugs on the reflex mechanism as they affect either the detrusor or sphincter factors. From the fact that the sphincter reflex recovers from the depressing effect of various drugs more rapidly than the detrusor reflex, he draws the conclusion that the reflex apparatus for the sphincter is much more difficult to paralyze than the reflex apparatus for the detrusor.

**The Cause of the High Value of the  $\frac{C}{N}$  Quotient of the Normal Human Urine.** As far back as 1865, Voit called attention to the fact that while urea gave for the quotient  $\frac{C}{N}$  the number 0.43, the entire urine gave for the same quotient a much higher value (0.7 to 0.8). From this fact he drew the conclusion that there must be in the urine other nitrogenous substances beside urea which have a high content of carbon or substances free from nitrogen. In the present communication, Dr. Fritz Pregl<sup>1</sup> examines this question and gives the following answer: Direct determinations of the urine give, in accordance with previous observations, a much higher value for the quotient  $\frac{C}{N}$  than corresponds to urea. The cause of this is only partly to be found in the presence of the other long-known organic constituents, such as uric acid, creatin, and hippuric acid. For the most part it depends on the presence of a substance called by its discoverers, Bondzynski and Gottlieb, oxyproteic acid (oxyproteinsäure), a component rich in carbon. This substance in most instances, from its amount, stands next to urea among the organic substances of the normal human urine.

## NERVOUS SYSTEM—SPECIAL SENSES.

**The Development of the Cortical Centres.** The question as to whether the cortical centres for voluntary movements are innate or the result of development *intra vitam* has again been studied experimentally

<sup>1</sup> Archiv f. d. ges. Physiologie, 1899, Band. lxxv. Heft 1.



by Dr. A. Bary.<sup>1</sup> He found that stimulation of the cortical centres with a weak faradic current in new-born dogs, cats, rabbits, and guinea-pigs produced movements of an entire extremity, but never isolated movements of individual muscle-groups; that it is only from the tenth day on, in cats and dogs, that centres exclusively for isolated movements are present. Notwithstanding these results, Bary does not believe that faradic excitation of the cortical centres in new-born animals can be compared with the normal physiological excitation, which, owing to the incomplete development of the cells, is insufficient to cause muscular contractions. He believes, from the anatomical considerations, that O. Soltmann's opinion with regard to the development of the cortical centres in new-born babies is still correct—namely, that in the new-born there does not exist the main group of movements which arise by volitional impulses from the cortical layer of the cerebral hemisphere.

**The Localization of Centres in the Spinal Cord for the Musculature of the Forearm and the Hand.** It was established some years ago that division of motor nerves, or removal of individual muscles and muscle-groups, was followed by degeneration of the nerve-cells from which the corresponding motor nerves were derived. The degenerative changes in the cells were made apparent by the staining method introduced by Nissl. With these facts, Wille, a few years ago, made several sections of the cord, after an amputation of the arm made four years before, and observed a diminution in the number of nerve-cells on the side corresponding to the amputation in the region of the third and fourth cervical nerves. In the present communication Flatau<sup>2</sup> records the results of similar observation. He made serial section of portions of all the cervical and the first dorsal segments of the cord of a man whose right arm had been amputated nineteen years before. An examination of the sections revealed on the side corresponding to the amputation an evident diminution in the lateral group of cells in the anterior horns, especially from the fourth and including the eighth segment. There was no diminution in the first, second, or third cervical segments, nor in the first dorsal.

An examination of the spinal cord of a child nine months old, who had had a congenital absence of the left forearm, revealed a diminution in the number and character of the lateral group of nerve-cells, more especially in the seventh and eighth segments. In the seventh segment ten sections contained 596 cells on the right side and 182 on the left. In the eighth segment ten sections contained 365 cells on the right side and but 18 on the left side. In the first dorsal segment no change was

<sup>1</sup> Archiv f. d. ges. Physiologie, 1898, Heft 4.

<sup>2</sup> Englemann, Archiv f. Physiologie, 1899, Heft 2.

discoverable. In regard to the second case, Flatau observes that it is not probable that the nerve-cells degenerated in consequence of the removal of the peripheral motor nerves, but that the cells were wanting from birth in consequence of "neuronagenesis." From these observations it is evident that the centres for the forearm and hand are located in the seventh and eighth cervical vertebræ.

**The Physiological Action of the Laryngeal Nerves.** The accepted but opposing views as to the effect of gradually increasing pressure on the inferior laryngeal nerve, whether it causes paralysis of the abductor muscle, posterior crico-arytenoid, or spasmodic contracture of the adductors, with a consequent median position of the vocal band, have lost some of their value since the remarkable experiments of Grossmann have been published. These experiments go to show that the median position of the vocal band is the effect of neither of the causes just mentioned, but of the normal action of the crico-thyroid muscle, inasmuch as it is observed after division of the nerve and after complete excision of all the intrinsic muscles of the larynx. Krause, whose clinical observations and experiments in 1882 inaugurated a long series of researches upon the functions of the inferior laryngeal nerve, has lately subjected his earlier experiments to revision and supplemented them by additional ones, the result of which induces him to accept in the main the views of Grossmann. He finds, again, that pressure applied to the infra-laryngeal nerve is followed by an immobility of the vocal band in the median position. This same position is maintained when the nerve, while subject to pressure, is divided near its peripheral terminations, which would indicate that it is not due to an irritation of the nerve nor to an irritation contracture. The position which the vocal band takes after division of the nerve Krause terms a position of adduction, as it is nearer to the phonatory than to the resting inspiratory position, though it is not quite so marked as during the application of pressure to the nerve.

This adduction position, however, as the present series of experiments shows, at once approaches that of inspiration as soon as the crico-thyroid muscle is paralyzed by section of the superior laryngeal nerve. It has been demonstrated that after division of the inferior laryngeal nerve a movement of the vocal band toward the middle line takes place, which is synchronous with expiration, and which is caused by the crico-thyroid muscle. When the external branch of the superior laryngeal nerve is stimulated, or even the muscle itself, the vocal band is drawn toward the middle line, though it is somewhat relaxed and excavated. If the same experiment is performed without previous division of the inferior laryngeal nerve, the band is drawn nearer to the median line and is made somewhat more tense. Laryngoscopic investigation, as well as

immediate observation of the crico-thyroid muscle, reveals the fact that it is an expiratory muscle cooperating automatically with other expiratory muscles. In conclusion, Krause admits that Grossmann's objection to his original interpretation is justified by experiments; that whether the inferior laryngeal nerve is compressed or divided, the position assumed by the vocal band is the same, and called forth by the contraction of the crico-thyroid muscle, which is to be regarded, therefore, as a supplementary adductor muscle. The muscle-groups which are enfeebled by the partial paralysis of the inferior laryngeal nerve are assisted in their efforts by the crico-thyroid, the action of which is synergic to their own. If, however, both the superior and inferior laryngeal nerves are simultaneously subjected to a paralyzing influence, then the vocal band will make in both directions only slight excursions.

**Movements and Innervation of the Small Intestine.** The physiology of the intestinal movements has proved a continual source of irritation, on account of the discrepancies caused by the varying behavior of the gut under the many different conditions that can affect it. It is, consequently, with pleasure that we report the careful work studied by means of apparatus by Bayliss and Starling.<sup>1</sup> The observations were made by means of a thin rubber balloon, introduced into the small intestine through a small opening in the unattached border, filled with water under a pressure of about 10 cm., and connected with a piston recorder. The experiments were all carried out on dogs. They conclude: There are two kinds of movements to be distinguished in the small intestine—viz., the rhythmic, pendulum movement and the true peristaltic contraction. The former are due to rhythmic contractions affecting the longitudinal and circular coats simultaneously, recurring about ten or twelve times per minute, and travelling along the intestine at a rate of from 2 to 5 cm. per second. They are myogenic in origin, and are probably propagated by means of the muscle-fibres. The peristaltic contractions are true coordinated reflexes, started by mechanical stimulation of the intestine and carried out by the local nervous mechanism (Auerbach's plexus). They are independent of the connections of the gut with the central nervous system, travel only in one direction, from above downward, and are abolished on paralyzing the local nervous apparatus by means of nicotine or cocaine. The production of the true peristaltic wave is dependent on the unvarying response of the intestinal nervous mechanism to local stimulation, *the law of the intestine*.

This law is as follows: Local stimulation produces excitation above and inhibition below the excited spot, the effect being dependent on the activity of the local nervous mechanism. Every point of the intestine,

<sup>1</sup> Journal of Physiology, 1899, vol. xxiv.

therefore, is subject to opposing influences transmitted to it along its wall—viz., inhibitory from above, excitatory from below—but beside these local influences every point of the intestine is under the control of the central nervous system through the intermediation of the splanchnic and vagus nerves. The splanchnics exercise a tonic inhibitory influence on the intestinal movements, affecting both longitudinal and circular coats; the vagus nerves contain two sets of fibres, inhibitory and augmentary. The action of the vagus is therefore twofold—an initial inhibition, followed by augmentation, which outlasts the excitation of the nerve. The action of the vagus is unaltered by atropine, but is permanently abolished by a small dose of nicotine.

**Inhibitory Fibres in the Vagus for Œsophagus and Stomach.** By quite a simple procedure Langley<sup>1</sup> demonstrated the presence of inhibitory fibres in the vagus for the lower end of the œsophagus and stomach. He employed, in order to show the dilatation of the cardiac sphincter on stimulation of the vagus, an œsophageal manometer. This consisted of a vertical tube containing fluid at a pressure of 15 or 20 cm., water-pressure, and connected with the œsophagus by means of a rubber tube. On stimulating the exposed vagus the sphincter opens and fluid passes into the stomach. Any factors which might be considered to falsify the conclusions were carefully eliminated.

## VISION.

**The Diffraction of Light at the Cornea and Lens.** Dr. H. Salomonsohn<sup>2</sup> concludes, from an exhaustive research, that the seeing of rainbow colors in conjunctivitis has its cause in the diffraction of light by cellular elements on the surface of the cornea, dead epithelial cells, mucous corpuscles, nuclei of cells, etc., but that the same phenomenon in glaucoma is caused by diffraction in the cortex of the crystalline lens.

**Studies in the Boundary Region of Localized Vision.** For the perception of light and darkness of the adapted eye, Dr. Sigmund Exner<sup>3</sup> draws the following conclusions from his experiments made upon himself:

1. The stimulations of two neighboring parts of the retina assists each other.
2. The stimulations of several retinal areas which are separated from each other flow together into one homogeneous stimulation, provided their intensity does not surpass a certain amount. The intensity of this latter stimulation is the same as if the real stimuli were to influence the whole affected retinal area in perfect distribution.

<sup>1</sup> Journal of Physiology, 1898, vol. xxiii.

<sup>2</sup> Englemann, Archiv f. Physiologie, 1898, Heft 3.

<sup>3</sup> Pflüger's Archiv f. d. ges. Physiologie, 1898, Heft 3.

3. The resulting even stimulation of a retinal area, whether it is caused by evenly or unevenly distributed light stimuli, does not measurably extend beyond its boundaries.

4. The stimulation of a retinal area suppresses weaker stimulations of the same kind in its neighborhood.

5. The area of a retinal image standing at the threshold of perception is approximately inversely proportional to the square of its distinctness. If the retinal images are very small their perception may be regarded as simply proportional to the quantity of light.

6. The more complex the outlines of the retinal images are, the greater must be their luminosity or their dimensions to just enter the threshold of our consciousness.

**Longitudinal Connections of the Human Retina.** Quite recently some new discoveries have been made as to the structure of the retina by Greff.<sup>1</sup> These discoveries teach us that the conductors of the light stimuli across the retina are not entirely isolated, but that there are connecting fibres running parallel to the surface of the retina and lying at different depths. The first connections exist at the bottom of the visual cells; the second occur among the spongioblasts or amacrine cells, and the third between the ganglion cells. Whether they serve to associate certain visual stimuli or not has not yet been decided.

**Is There a Free Communication Between the Anterior and Posterior Chambers of the Eye?** Dr. Carl Hamburger<sup>2</sup> has brought forward some experiments which throw some doubt on the truth of the accepted teaching of modern ophthalmology, that the pupil affords constantly a free communication between the anterior and posterior chambers of the eye, through which the aqueous humor secreted by the ciliary bodies flows in a constant stream into the anterior chamber, which is again drained off by the spaces of Fontana. He shows by apparently conclusive experiments that such is not the case; that there is no constant communication between the two chambers; that such communication physiologically only exists in profound darkness after the pupil has thoroughly dilated; that the explanation for this lies in the fact that the iris is closely drawn to the anterior surface of the lens by the tissues of the sphincter muscle, assisted by the pressure of the fluid in the anterior chamber. This view of Hamburger's is based on experiments such as the following: A solution of Berlin blue was injected directly into the posterior chamber of the eye of an animal. It did not pass through the pupil, but accumulated in a ring-formed manner behind the iris, the pupillary region remaining free. Fluorescein was injected into the pos-

<sup>1</sup> Englemann, *Archiv f. Physiologie*, 1898, Heft 3.

<sup>2</sup> *Ibid.*, Heft 4.

terior chamber. Notwithstanding the extreme solubility and coloring power of this substance, the pupillary region did not show any evidence of its presence, even after the lapse of fifteen minutes. Puncture of the anterior chamber, which relieves the pressure against the iris, is at once followed by the passage of the fluorescein into the anterior chamber through the pupil. Hamburger further states that pathologically this communication occurs in inflammations of the ciliary body, where an increased secretion overcomes the force of the sphincter muscle of the iris. The aqueous humor in the anterior chamber is, according to him, secreted mainly by the anterior surface of the iris and only to a limited extent by the ciliary processes.

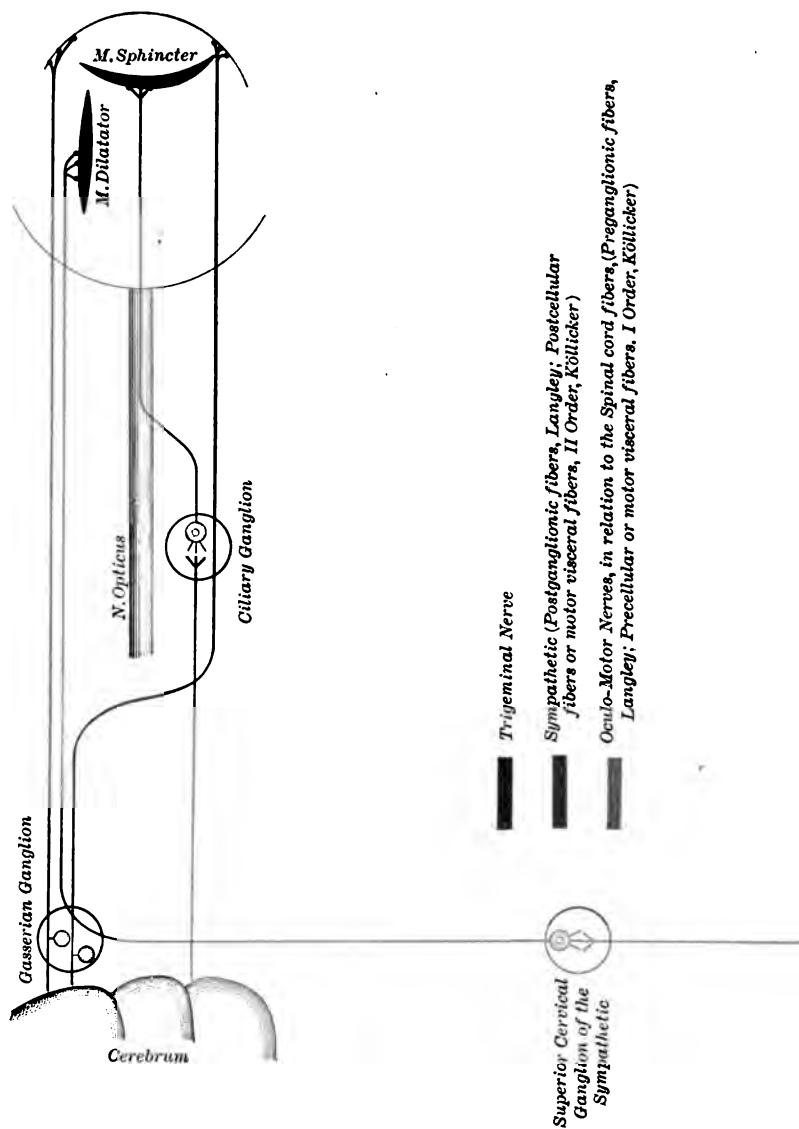
Lévinsohn<sup>1</sup> attacks the views of Hamburger, mainly on the ground of his experimental work. He shows that a careful injection of the fluorescein into the posterior chamber and not into the vitreous, as he believes was done by Hamburger, and without losing a drop of the aqueous humor on the withdrawal of the syringe, produces a coloring of the anterior chamber at once. He therefore upholds the views of Leber, that the iris touches the lens very slightly, as is also shown by the constant play of the pupil.

**The Mode of Action of the Mydriaca and Myotica.** In a paper on the effects of drugs which produce changes in the diameter of the pupil, Schultz<sup>2</sup> calls attention to the "philological barbarism" of the term mydriatica, which should be discarded for the term mydriaca. Before proceeding to offer experimental evidence as to the manner in which the physiological mechanism concerned in enlarging and diminishing the size of the pupil is modified by the drugs used in ophthalmic practice, Schultz states his belief in the existence in the iris of a dilatator pupillæ muscle as proven beyond doubt. The interpretation of the relation of the oculomotor nerve-fibres to the terminal neurons, which have their origin in the superior cervical ganglion and in the ciliary ganglion, as well as the relations of the latter to the muscle of the iris, is summed up in Plate V. With this physiological mechanism in mind the author conducted a series of experiments, with a view of determining the exact seat of action of the mydriaca and myotica. The mydriaca atropine and cocaine produce dilatation of the pupil—the former by paralyzing the nerve-endings of the constrictor nerve-fibres of the iris, and the latter primarily by paralyzing the endings of the sympathetic neurons, and secondarily by paralyzing the terminals of the constrictor nerves. The myotica physostigmine and muscarine produce contraction of the pupil by stimulation of nerve-endings in the sphincter

<sup>1</sup> Englemann, *Archiv f. Physiologie*, 1898, Heft 5.

<sup>2</sup> *Ibid.*, Heft 1.

PLATE V.







muscle. Schultz finally arrives at the following conclusion, important to the neurologist and ophthalmologist: In cases of ophthalmoplegia interna and paralysis of the external branches of the oculomotor, and in which physostigmine is still effectual, the nerve-path for the impulses which lead to contraction of the iris sphincter can be diseased only as far as the ciliary ganglion, and that, therefore, the sympathetic end-neuron, which begins here, must be intact. If, however, after a frequent instillation of physostigmine the pupil is not narrowed, it may be concluded that the degeneration has extended beyond the ciliary ganglion, and that the nerve-terminals in the sphincter are destroyed.

**Comparative Researches as to the Acuity of the Senses of Blind and Seeing People.** Prof. Dr. H. Griesbach, in a very extensive article describing his experimental studies, comes to the following conclusions among others: For the perception of tactile impressions there exists in general no considerable difference between the blind and seeing; small differences speak rather in favor of the seeing. In people who have been born blind the tactile acuity is somewhat less marked than in the seeing.

Blind people, especially with their finger-tips, have less feeling than seeing people. They also require, especially in the region of the hand, a stronger impression than the seeing individuals, in order to obtain an undoubted tactile perception. In the faculty of localizing auditory impressions, as well as in the distance of distinct hearing, there is no difference in the two classes of individuals. There is also no difference in the olfactory acuity.

**The Physiology of Smell, Taste, Sensations of the Skin, and Senses in General.** The old question as to whether there is any specific difference in the constitution of nerves has again been raised by Rollet.<sup>1</sup> In a very elaborate paper he relates in detail some interesting experiments on the effects of ether and chloroform on our senses, and also some observations on artificially produced anosmias. He then enters into a general discussion of the physiology of sensation, and calls attention to the fact that the old doctrine of the identical constitution of nerves has to be abandoned, on the ground of new histological and physiological observations. He then develops his conception of what he calls the *idiotrophy* of the specific tissues, especially of the neurons. By this term he would have us understand the adaptation of the neurons to their adequate stimuli, by means of which they finally react only to their own specific stimulus. For the skin, he comes to the conclusion that special nerves for pressure, warmth, cold, and pain have to be assumed for the explanation of the observed facts.

<sup>1</sup> Pflüger's Archiv f. d. ges. Physiologie, 1899, Heft 9.



# ANATOMY.

BY FREDERIC HENRY GERRISH, M.D.

**Introductory.** Those whose attention has not been especially directed to the subject will be surprised to find that a great deal of progress is constantly being made in the science of anatomy. Discoveries of as revolutionary a character as that of a few years ago concerning the forms and relations of nerve-cells are, of course, extremely uncommon, as also are comparable things in practical medicine—such, for example, as serum-therapy—but patient workers in this field are continually making additions to our knowledge, and these are so numerous as to produce in a few years a decided impression upon this science.

The principal facts of gross anatomy were known hundreds of years ago, but many macroscopical details were overlooked by the anatomists of the distant past, and of microscopical structure they knew nothing. The great activity in research which has been displayed by our immediate predecessors has supplied many of these deficiencies, but there is still ample opportunity for discoverers.

Although it would be easy to fill the pages allotted to this subject with a rehearsal of the contributions which have been made recently to our stock of anatomical information, it seems to me best to devote the space this year to the consideration of the reform of anatomical terminology, which has been suggested and actively discussed during the past twelve-month. I have been led to this determination by two principal considerations: First, that while some of the contributions which have been made in the last year are of considerable interest, none are so supremely important that the practitioner will suffer for lack of information concerning them; and, second, that the matter of nomenclature, though it has received a great deal of attention among anatomists on both sides of the Atlantic, has not for many years, as far as I am aware, been presented to the medical profession generally in a comprehensive article, from which one may learn of the changes which have been proposed, the arguments *pro* and *con*, and the action of the various scientific bodies which have expressed themselves upon the subject.

## ANATOMICAL NOMENCLATURE.

The nomenclature of anatomy must be admitted by all to be a matter of importance, because upon it is based to a very large extent the termi-

nology of the other departments of medical science. On this very account radical alterations in the existing nomenclature should not be made except for good and sufficient reasons. The great increase of anatomical knowledge in every direction has necessarily attracted attention to the character of our nomenclature more markedly than ever before, and is the principal ground upon which the demand for revision is based; for the subject becomes important in proportion to the extensiveness of the science and the number of persons who are now and are to be at work in it. I hope to show that there is crying need of improvement in anatomical terminology, and that the changes would best be effected along lines which have been laid down by English-speaking anatomists.

**The Current Nomenclature.** It is doubtless true, as somebody has said, that of all the attributes of an object its name is the least important; but however insignificant in a relative way names may be, absolutely they are of great value. A surgeon performing an operation in a region of the body with whose anatomy he is perfectly familiar does not name to himself the various structures in the path of his work, though he heeds all of their physical qualities and the peculiarities of their relations; but when he needs to describe his performance, the names of the parts involved are essential, and it is of great importance to his hearers, who wish to learn what he has done, that each of the terms that he uses shall bring up a picture of such definiteness that it cannot be confounded with anything else. Hence, it is necessary that the nomenclature of anatomy should be such as will enable those who use it to communicate their thoughts with perfect precision, and it is extremely desirable that it should be possible to do this without needless expenditure of time and effort.

If our current terminology meets these requirements there is no call for measures of reform; if it does not satisfy demands so reasonable, its defects should be promptly recognized and corrected with all possible speed.

It will not require a protracted examination to ascertain that the nomenclature of anatomy is a jumble of terms of the most varied origin, form, and purpose; that it contains elements of great difficulty and confusion, and that instead of being always an assistance to the acquisition of knowledge, it is not infrequently an obstacle thereto. Indeed, it has long been seen that its nomenclatural defects are an impediment to the progress of the science.

This is a serious indictment, but details which will presently be given will demonstrate its justice. Most students have recognized pronounced blemishes, and many teachers have endeavored to correct in some measure the existing faults. I have before me, as I write, a translation of the almost forgotten work of Sarlandière, who fully appreciated the situ-

ation, and invented a system for its reform. Some of the statements in his preface are not without meaning at the present day, as, for example, the following: "The greatest difficulty in the study of anatomy lies not in the inspection of objects but in the number of names or words by which they are represented, in the faulty classification of these words, in their irregularity and often incorrect signification, and lastly in the want of a graphic method." His scheme is only a curiosity now in spite of the great ingenuity which he displayed in its construction. What a pity it is that the success of his system fell so far short of justifying his supreme confidence in its efficacy, as shown in his opening sentence: "I have perfectly satisfied myself that a knowledge of the science of anatomy, in all its parts and even in its details, may be acquired in fifteen lessons, . . . each of two hours' duration."

The large majority of living medical men who studied anatomy many years ago have probably forgotten the greater part of what they learned in their pupilage, and there has also lapsed into oblivion the memory of what they endured in their efforts to obtain the desired knowledge. The names of the organs with which they have had constantly to deal have remained in their minds, and are now so familiar that the idea of difficulty in learning them seems strange. The same is true of many teachers of anatomy, and of some it may be said that they seem to revel in reeling off the longest possible names in the presence of their wondering auditors, actuated apparently by a desire to create an impression of the prodigious extent and profundity of their learning. The students meanwhile are floundering about in the bog of terminologic absurdities, and in proportion to the obstacles which they encounter, are getting a dislike for a branch of science which ought to be made attractive. Those of us who are interested in promoting a reform are not considering chiefly the convenience of the anatomists who have already acquired a nomenclature, though help can be given them in proportion to the extent to which they still devote themselves to the science, but we have principally in mind the urgent needs of the present, and especially the future, students, the number of whom is incalculably greater than that of the surviving members of the profession.

Let us see what the defects of the current nomenclature are, consider the principal suggestions for their correction which have been made in recent years, and determine the principles which should guide us in the work of reform.

**DEFECTS OF THE CURRENT NOMENCLATURE.** We find that many objects have more than one name, and *vice versa*; that a host of terms are personal in form; that many contain a superfluity of words; that some are of unnecessary length, although composed of but one word; that a large number are incapable of adoption into the vernacular of all civilized

languages without essential change of form ; that some are variable in form ; that a good many affect to be descriptive and are not ; that others convey a positively misleading conception ; and that whole classes of terms are not applicable equally to lower animals and to man, although uniformity in this regard would be of prodigious assistance to all anatomists.

These seem to me to be the faults most worthy of mention, and they certainly constitute an array of no mean magnitude. One other fault often advanced is the polyglot character of some words—their derivation from more than one language. There is force in this criticism, for it is a satisfaction to a purist to be able to trace the words which he uses to a parentage of unimpeachable standing. On the other hand, it may be argued that some hybrid words are very useful and not uncomely, as may be said also of mules and quadroons ; and as utility is the main purpose which we have in view, it would be overfastidious to reject a term which met this indication simply because it came of a mixed stock.

It is easy to understand how such a conglomeration has been effected. The growth of the anatomical vocabulary has been not unlike that of our vernacular. In the earliest times the people had names only for those parts and organs which were within easy sight, or became so as the result of wounds. When attention was bestowed systematically upon the structure of the body it was natural that the parts which were discovered should be named from their real or fancied resemblance to common objects, from their supposed function, from their size, shape, consistence, color, and other attributes, genuine or imagined, or perhaps a combination of two or more of these. Even the fact that no appropriate name was thought of was sufficient to form the basis of a title, and *innominate* was applied to a few things which thereafter presented the paradox of having a certain name because they were nameless. It is evident that no deliberately formulated principles underlie such a nomenclature.

It would be unseemly for us, in the pride of our present knowledge, to hold our predecessors in contempt, on account of the crudeness and imperfection of their results, for it is not probable that we would have been more successful if we had been placed exactly in their position. Indeed, we occasionally see attempts at word-making in this age of enlightenment which are far from furnishing a warrant for our thrusting the tongue of derision into the cheek at their nomenclatural misadventures. Doubtless, if we could clear the board and begin anew our terminology would be a vast improvement in every respect, provided (and this is most important) that the work of revision were intrusted to men who were not only expert anatomists, but also equally interested in and skilful at the devising of appropriate designations for objects ; for

it is manifest that the two qualities are not always associated in the same individual, and the latter is quite as important as the former in the task of constructing a new nomenclature.

### BASIC PRINCIPLES OF A NOMENCLATURE.

If we were to undertake to form an ideal terminology almost all of us would agree that the following rules should be observed :

The words should be Latin in form.

They should be of Greek origin as far as possible.

The terms should not attempt to be descriptions.

They should be designations.

Terms consisting of only one word should be given the preference over terms consisting of two or more words.

Shorter words, as a rule, should be preferred to longer words.

Each object should have but one name.

A given term should be applied to but one object.

The names of persons should not be included in the designations of objects.

The terms indicative of position and direction should be equally applicable to all vertebrates.

A change as thorough as would be effected by the absolute application of these rules would necessitate the rejection of a great number of terms which, while not ideal, have rendered good service for many years. Such of them as are not in serious conflict with the basic principles of the reform should be permitted to remain, for nobody purposes a complete overturning of our vocabulary or desires any changes which are not founded upon utility. Conservatism should be practised whenever it is not inconsistent with essentials, and radical alterations should be made only when really necessary.

Let us now consider each of the points in turn.

**Latin Form of the Words.** The words should be Latin in form, because Latin is the language of the nomenclature of the other departments of science. There is universal agreement, moreover, that the nomenclature of all the sciences shall continue to be in Latin. The advantages of this system must be manifest to some extent even to a superficial observer. The American student of anatomy may not be able to make head or tail of the vernacular of a French fellow-dissector, and the latter may regard all of the talk of the former as *jargon*; but let either of them say "caput" or "cauda," and light breaks in on the darkness, and they get things right end foremost at once. Latin is selected for scientific terminology because of its universality—

it is understood the world over as is no modern tongue—and because, being as it were crystallized, it is not subject to the changes incident to all living languages. Naturally, one does not expect to find in Latin lexicons all of the words which a medical dictionary contains; for so many things which were unknown to the Romans have been discovered or created and have become necessities of modern medicine, that large additions have been made to the vocabulary, the words sometimes being derived from classical roots and sometimes manufactured with utter disregard of the speech of the ancients. Anatomy, like every other science, has its share of these words which cannot trace their genealogy back to an acknowledged Roman source; but they are fully adopted into the family, and to all appearances are as respectable as those that can boast an ancestry of the most aristocratic blood.

By insisting that the vocabulary of anatomy should be strictly Latin in form, I do not mean to imply that the Latin name should always be used in the designation of parts which have well-known and unmistakable vernacular equivalents. There are a few of these which are invariably mentioned by the titles which the common people have for them; and it would be utter pedantry for scientific men to speak of *cor*, *hepar*, and *ren* in conversation with those not educated in anatomy instead of using terms which would be readily understood. The number of such words in English is absolutely small and comparatively very insignificant, and it is no hardship to have to learn a Latin synonym for each of them. The point which it is desired to make is simply this, that every object in anatomy should have a name which is Latin in form—a rule most conscientiously followed by botanists and zoölogists. Thus we are enabled to have a strictly *international nomenclature*—one equally clear in every country where anatomy is cultivated.

**Vernacular Equivalents.** Excepting those parts which were recognized by the people everywhere, and had vernacular titles before scientific anatomy existed, and also those parts which are invariably called by their Latin names, each organ should have in each modern language an equivalent designation, so like the technical as to be known immediately as its synonym and yet possessed of the characteristics of its own nationality. To illustrate, the Latin *nervus* is *nerve* in English, *nerf* in French, *nerv* in German, *nervo* in Italian—the word in each language retaining the essence of its etymon, and thus being infallibly recognizable everywhere, and yet being so modified as to acquire a form peculiar to its own vernacular. We have many such English representatives of Latin words, and they are found to some extent in other modern tongues. The Germans seem to have a deeply rooted antipathy to words formed in this way, and seem to want everything belonging to them to be cast in a distinctly German mould. So they say wind-pipe-head (*Lufttröhren-*



kopf) instead of larynx, which is classical, shorter, recognized everywhere, and easily changed to an adjective form. By such means they increase enormously the difficulties of the anatomical students of their own as well as of other lands; but there are indications of a tendency to reform, and we may hope for better things in time, counting it as an earnest of future conversion that they have substituted in most scientific works the clear Roman type for the gnarled, twisted, grotesque characters which a gifted philologist has ascribed to the perverse ingenuity of the mediæval monks.

**Greek Origin of Words.** While the form of our anatomical words should be Latin, their derivation, as far as possible, should be Greek. Already a large proportion of our technical terms are examples of this rule. They are Athenians scantily disguised in Roman togas. When a new thing is discovered we should determine, as nearly as we can, what the Greeks in the palmy days of their language would probably have called it; then we dress the word up in Latin apparel and adopt it into the family of anatomical terms.

It is noticeable that there are those who are so deeply in love with the methods of the Germans that they can see little or no good in things which emanate from other sources; and they advocate the incorporation of German words in our anatomical vocabulary. For example, *anlage* is used by them instead of *rudiment* and *fundament*, meaning the primary constituent of an organism, the primitive, undifferentiated mass. A prominent embryologist defends this method with the argument that every anatomist must know German, but none need know Greek; but if this line of reasoning were carried to its legitimate conclusion we would find ourselves begging for a Teutonic christening of every discovery which we were fortunate enough to make. To my thinking, *proton*, from the Greek *πρῶτος*, is immensely superior to *anlage*, not only because the mind immediately perceives its relationship to other and familiar words which are partly from the same source and are associated with the thought of firstness, but also because, coming from a classical root, it is exactly in line of derivation with almost all of the technical names of scientific medicine. This objection should not be construed into a lack of appreciation of our indebtedness to the great peoples which have made wonderful contributions to our knowledge. It is simply a protest against what seems to me a very mischievous movement. No living tongue should be used as the basis of an international terminology; but if this principle is to be ignored, our own English has better claims to recognition in the premises than any other.

**Descriptive Terms Impracticable.** No attempt should be made to have the terms completely or even approximately descriptive, for the effort would almost inevitably be abortive; and in any event the term

would be intolerably long. Take, for example, *corpus pyramidale striatum inferius externum posticum*, and *iter à tertio ad quartum ventriculum*. Worse still, consider the case of the vagus nerve, frequently called pneumogastric, a name which implies its distribution to lungs and stomach. If we make a word merely on the basis of its complete distribution, and leave out of account all mention of its origin, course, size, relations, etc., the result will be *nervus meningo-cutaneo-pharyngo-oesophageo-laryngo-tracheo-broncho-bronchio-cardio-pericardio-hepato-lieno-pneumo-gastricus*. The most exacting stickler for descriptive nomenclature would be likely to shrink from frequent pronunciation of so appalling a name as that—one, too, which in spite of its enormous length falls far short of approximate completeness in the line of description.

**Designatory Terms Desirable.** The terms should be designatory. By this is meant that the name should unfailingly call up the thought of the exact thing intended, and of no other. By the operation of this rule structures are often made to bear appellations which, taken independently, contain no suggestion of the object to which they are attached. By long association with a part the name has come to carry an acquired signification, and the second meaning is the only one which is thought of when the word is seen or heard. When *vena salvatella* and *vena basilica* are mentioned we think of certain bloodvessels, and the original significations, “the little savior vein” and “the king’s vein,” are not suggested. This is consonant with common usage. We say Cornhill, Old Orchard, Wall Street, without a thought of the maize which gave the name to the one place, the fruit-grove to the second, or the ancient masonry, at once the boundary and the bulwark of the metropolis, which was the origin of the third. That the original reason for a name has lapsed is no warrant for its rejection. Fond parents who have given their baby the seemingly appropriate name of “Grace,” do not feel called upon to change it when it is discovered that she is an awkward young woman; and the child “Patience” may develop into a fretful and irascible adult, without anyone’s being confused by her name, which is used simply in a designatory way.

The effort should primarily be to have an unmistakable designation—the meaning should be invariable. This being done, there is no objection to the word’s conveying any information of a descriptive kind, as concerning some attribute of the object, as far as it can do so without violating the rule of brevity.

It is important, however, that a name should not be practically misleading. *Supinator longus*, for example, should be discarded, because the muscle whose action it affects to describe is no more a supinator than it is a pronator, and is much more a flexor of the forearm than it is either of the other things.

**Single-word Terms Preferable.** Terms consisting of only one word should be given the preference over terms consisting of two or more words.

The advantage of single-word terms on the score of brevity appeals to one immediately. Occasionally, it is true such a term contains more syllables and more letters than some terms of two words; but this is exceptional, and words of great length are rarely necessary. Other things being equal, the shorter the term the better, and the desirability of brevity is proportionate to the frequency of the employment of the term.

Another merit of single-word terms is their capability of furnishing adjective forms which enable us to refer to parts and relations of organs with greater facility and conciseness. A term from which an adjective can be derived is vastly superior to one which cannot be thus inflected. How easy it would be to form an adjective from *risorius*; how impossible to conjure one from the neighboring *levator labii superioris alaeque nasi*! We have *patellar*, *phalangeal*, *occipital*, *cerebellar* and a host of others derived from single-word terms; but we have to do without the convenience of adjectives in many cases, on account of the utter impracticability of making them from the polyonymic terms with which many parts are burdened, and instead have to make use of a tedious and clumsy circumlocution.

A single-word term lends itself to the formation of compound words with a readiness which terms of more than one word cannot approach. It has a far greater capability and probability of adoption into other languages without undergoing changes which interfere with its recognition.

There are various ways in which a single-word term can be formed from a term of more than one word. The simplest is by omitting all of the term but one word. When this method is adopted the most distinctive word should be chosen to represent the term—there should be a survival of the fittest. Thus *longissimus dorsi* may be abbreviated by dropping the last word without detriment to the clearness of the term, because there is but one thing in the body which anybody calls *longissimus*. From *pia mater* and *dura mater* it is manifest that *pia* and *dura* are the words which will most readily convey the intended meaning. To be sure, they are adjectives not nouns; but there are plenty of illustrations of the employment of this part of speech in exactly this manner. We say “dancing on the green,” “a bolt from the blue,” “stripping to the buff,” and nobody thinks it needful to append “sward,” “sky,” and “skin”—the nouns being unnecessary because the adjectives have acquired the force of nouns. There are many terms in our nomenclature which may well be reduced to their adjective constituent.

The reduction to a single word may be accomplished by compounding two or more elements of the term; but this gives little or no relief of

the difficulty from undue length. Appreciation of the convenience of single-word terms should not lead us into making combinations of several words, since these are often nearly as oppressive as are terms of two or more words. The cumbrous polysyllables so frequently encountered in German are cases in point. If, however, one element of the term is an adjective indicating topical relation, the corresponding preposition may be substituted for it, thus conveying the exact meaning in a more laconic way. For example, instead of *anterior commissure* we may say *præcommissure*; for *posterior cornu*, say *postcornu*; and nobody can mistake our meaning.

It has been urged that the single-word terms should not be monosyllabic, because these are thought to be less euphonious than dissyllables and trisyllables. It is true that a monosyllabic language, such as the Chinese, seems tedious to us who are accustomed to those which present a variety of forms; but there is no danger of getting too many monosyllabic names in anatomy. We do not string together a lot of terms in the style of a catalogue. The anatomical names are scattered through our descriptions like raisins in a pudding, and even if they were all monosyllables, the fact would not prove offensive, and would probably not be noticed. There are but few monosyllables in our technical anatomical vocabulary, and there is no occasion for anxiety lest in the formation of new terms those of one syllable shall predominate or even make a conspicuous display. Of the less than seventy Anglo-Saxon names for parts and organs, about two-thirds are monosyllables; but we experience no annoyance from this fact.

There are many terms which cannot be reduced to a single word. The designation of an organ which is one of a great group of similar structures illustrates this. Every muscle has two words in its name, the first of which is *musculus*. Practically, however, this generic is not expressed, and thus many are reduced to single-word terms. *Trapezius*, *popliteus*, *gastrocnemius*—each can be mistaken for nothing else, and is, therefore, sufficient. We treat the names of some bloodvessels in the same way, omitting *arteria* and *vena*. In certain cases we do not thus abbreviate the term, explicitness demanding two or even more words to convey the desired thought. Of course, it would be possible to give to each individual in a group an arbitrary name (a numerical designation, for example, as convicts are labelled); but nobody has carried the principle of single-word terms to that extent, and such a plan is not likely to be proposed.

**Short Words Superior to Long.** Where two words are equally valuable in a designatory way the shorter should be preferred. For example, take *pneumogastric* and *vagus*, which are used synonymously. The latter is only half as long, is quite as clear, is as pleasing to the ear, has as good historic backing, and, consequently, is the better word.

**One Name for Each Object.** It is interesting to observe how numerous are the names for a single part. Macalister says: "In the literature of anatomy over 14,800 names have been applied to about 7200 parts." While I have made no reckoning in the matter, my impression would lead me to credit a statement of much greater difference between the numbers of the names and the parts. Fortunately, most objects are not burdened with such a load of names as that which is most frequently called *hippocampus minor*, whose other appellations are *ergot of Morand*, *eminentia unciformis*, *colliculus*, *unguis*, *calcar aris*, and *calcar*. Some others are in a worse plight. The inferior peduncle of the cerebellum has more than twenty distinct Latin names.

In every case where a part has more than one name, that one should be chosen which has the best combination of claims based upon precision of meaning, brevity, historic usage, and euphony, excepting those cases where all of the titles are cacophonous, ambiguous, or too long, and then we are justified in the creation of a new term, the exploitation of which will doubtless evoke sufficient criticism to expose all of its weaknesses as well as demonstrate its merits.

**A Given Term Should be Applied to but One Object, and Should be Used in only One Sense.** The propriety of this stipulation is so obvious that there should be no need of argument in its favor, but our present terminology has many violations of this rule. For example, the word *sinus* is applied to certain venous channels, to chambers in bones, to spaces between the pia and the arachnoid, and in surgery to certain pathological tunnels. Some cases may be treated leniently because the context will always prevent misconception. Where neighboring parts have the same name all but one should be provided with other designations.

**Personal Names Objectionable.** The names of persons should not be included in the designations of objects.

The number of parts which in the current terminology bear the names of individuals is very great, doubtless some hundreds. Several of the characters who are thus celebrated are mythical, or at best not strictly historic, as Achilles, Venus, Diana, Adam; but almost all of the eponymics serve to perpetuate the memory of men who have discovered and first described the organs and parts to which their names are attached. From one point of view this method of designation is attractive, and appeals strongly to our sentiment of gratitude to those who have deserved well of us by their learning, skill, and patient research; except for the work of such as they knowledge of our bodies would not have advanced in four hundred years. Probably few if any of them affixed their names to their discoveries, but their associates and immediate followers took pleasure in crediting these great men with the performance of wonderful

things, moved thereto by a sense of justice or by neighborhood pride. It may have been purely filial duty, but it is open to the suspicion of family vanity.

There are serious objections, however, to this method of nomenclature. It makes terms unnecessarily long and involves the use of two words. Where an investigator has been particularly successful in making discoveries his name may be associated with more than one object of a similar nature, and it is confusing to have two distinct corpora labelled with the name of the same person, as in the case of Malpighi. It is by no means certain that fair play is given in all cases to the real discoverer—the prize has in some instances been bestowed upon the wrong person. Many equally deserving, some even more meritorious cognomens, not having been moored to an anatomical buoy, have been allowed to sink into the waters of oblivion. And however desirous we may be to do full justice to these few hundreds of our predecessors, are not the interests of our numberless successors of vastly more importance? The history of medicine should be studied by all physicians; but nobody learns anything of it from the often fortuitously selected eponyms of anatomical terminology. How large a percentage of doctors know anything about Havers, Peyer, Corti, Reissner? And think of the thousands of students who are struggling unsuccessfully to pronounce correctly Hesselbach, Vieussens, Cotugno, Morgagni, Purkinje, Giannuzzi and many other surnames of anatomical masters.

If one admits the desirability of the eponymic method in anatomical nomenclature, the logical conclusion will be the use of the names of persons as the specific designations of parts, just as in electrical parlance Watt, Ohm, and Ampère, the surnames of distinguished physicists, have been applied to the units of power, of resistance, and of current respectively. Our vernacular has many such cases, as Brougham, Gladstone, Boycott, Phaëton, Guillotine. Already there is one anatomical term which may be considered as upon this plane—Hymen, the fabulous god of marriage. Why not apply the principle in the case of his reputed mother and call the neighboring mount which has so long borne her name simply Venus? By the same method the heel-cord would become Achilles and the laryngeal prominence Adam, whose forbidden apple has so long stuck in the throat of all his sons.

The few hundreds of parts already bearing the names of historical and mythological personages having been thus reduced to single-word titles, it would be an interesting labor to extend the method and supply the remaining thousands of objects with proper names derived from history, legend, and romance. The field opened by this suggestion is most inviting as we consider how aptly the physical qualities and relations of certain organs would illustrate the mental and moral attributes of cele-

brated characters, thus fixing biographic data and enforcing ethical principles. The fornix might typify the archness of Dido, and its chief English derivative would be seen to display a certain kinship to her best-known performances. The callosum might be made to recall the rigidity of Brutus or Rhadamanthus, the double character of certain organs the duplicity of Ananias, and so on. Seriously, however, there can be no enduring opposition to the abolition of personal names in anatomy, for their disadvantages are very apparent and their benefits infinitesimal.

**Terms of Location and Direction.** In the case of many terms indicating location and direction serious difficulties are encountered when comparisons are instituted with the bodies of lower vertebrates. Toward the head is "upward" in man, but it is "forward" in an animal whose vertebral column is normally horizontal; toward the coccyx is "downward" in the human, but "backward" in the brute: and in like manner "forward" becomes "downward," and "backward" is changed to "upward." A few comparative anatomists describe all vertebrates as if in a vertical position, but the relief thus afforded is not great—it is not easy to think constantly of a pig with his nose in the air, when we always see him with that important organ at the ground.

One may object that he is not a comparative anatomist, and, consequently, does not care whether or not the terms of human anatomy are such as to be equally applicable to other animals than man; but this is a very narrow view of the situation. We are bound to recognize the fact that soon there will be a vast and ever-increasing number of students to whom it is of great importance that, as far as possible, there should be a uniform nomenclature for all vertebrates. In a decade all respectable medical schools will require of every student who applies for admission some genuine knowledge of comparative anatomy, especially as it concerns animals of the vertebrate type, as an absolutely essential preliminary to the study of human structure.

But leaving comparative anatomy utterly out of the question, the subject demands attention, even if one is interested in the study of only the human organism. In dissection work where the subject is horizontal, as is usual whether its decubitus is dorsal or abdominal, the same difficulty is experienced—the mind is obliged to readjust itself for every change of attitude of the cadaver, it must translate the terms which were made for the conventional vertical position into others which fit a different one. That the adjustment frequently is not made, even by the leaders who are looked to for good example in terminology as in all else that concerns the science, is clearly demonstrated by various names. The muscle which occupies the venter of the scapula is called "subscapularis," but it is *under* the scapula only when the subject lies on its belly.

The muscle which is inserted into the upper part of the synovial membrane of the knee-joint has long been known as the "subcrureus," but it is *under* the crureus only when the subject lies on its back.

Entirely aside, however, from the confusion which arises from changes in the attitude of the body, there are perplexities inherent in the terms which are generally employed. For example, take the terms "inner," "inside of," "internal to," "within"—are we not often dependent upon the context to inform us whether the meaning is that one of two objects is beside the other and nearer the middle line than it, or that the one is inclosed in the other? The need of terms whose meanings are unmistakable must be manifest, and it is certainly desirable that their intent should be conveyed without circumlocution.

Careful analysis will show that (1) a part of the difficulties in the case comes from our standard of relations and (2) a part from inherent vagueness of terms.

Ordinarily we reckon location and direction of parts with reference to the relation which an animal sustains to the surface of the earth. If the creature has an erect attitude terms of location and direction which are applicable to his parts and organs cease to be appropriate when applied to those of one whose vertebral column is horizontal, and to his own when his position relative to the earth is altered. Hence "upward," which means "in the direction of the head" in man, signifies "toward the back" in a quadruped and "toward the belly" in man, if the body is lying in the attitude commonest in the dissecting-room, where human anatomy is most securely learned. This kind of perplexity is unavoidable as long as we persist in employing the present method of nomenclature.

The way out of these annoying contradictions, which necessitate incessant readjustments of our mental attitude according to changes in the attitude of the body that we are studying, is by discarding altogether the terms which are based upon relations to any outside object, even though that object be the great ball upon which we live, and to *regard only the relations of the parts of the body to each other*. Then we may dissect a man, a menobranchus, or a magpie, a cat, a cod, or a cobra; we may hang them up by head or tail, or lay them on back, or belly, or side, and the terms which we use to indicate the position or direction of any part will be absolutely clear in every case, and will need no change in the transference of the idea to the corresponding part of any other animal, whether biped or quadruped, bird or batrachian, fish or reptile.

Already we have a number of such terms in more or less constant use. Such are "central" and "peripheral," "median" and "lateral," "dextral" and "sinistral," "afferent" and "efferent," and some others



have so far commended themselves to scientific writers as to have received an introduction into a number of recent articles and books. As examples of the latter class may be mentioned "dorsal" and "ventral," which are becoming rather frequent, and "cephalic" and "caudal," which are equally deserving but not yet accorded the same position of respectability. Finally, two others, younger and still considered upstarts by the ultra conservatives, and therefore unworthy of any recognition, are "ectal" and "ental," which it seems to me safe to predict are bound to take rank with the best of their fellows in the esteem of the thoughtful and instructed. All of these words are terms of position with the exception of "afferent" and "efferent," which indicate direction; but they can be changed from their adjective form into the adverbial by the addition of *ly* except "cephalic," which calls for the appendage *ally*, and then would become terms of direction. In this form, however, they are clumsy and rather difficult to manage, and long ago Barclay proposed the termination *ad* (the Latin for *to*) as a substitute for *ally*, and this form of the adverb has been received with such favor that it is likely to be used generally by all who adopt the one principle of topical terminology which is here advocated.

Let us now examine this dozen of adjectives of position and their corresponding adverbs, and see in just what way they are an improvement upon the terms by means of which we strive at present to convey our ideas of location and direction.

*Cephalic* means position in, *cephalad* means direction toward, the head-end of the body. In human anatomy cephalic is equivalent to superior, upper; and cephalad to superiorly, above, upward.

*Caudal* means position in, *caudad* direction toward, the tail-end of the body. In human anatomy caudal is the equivalent of inferior, lower; caudad of inferiorly, down, below, downward, lower.

When the limbs are in question, *cephalic* means the radial and tibial sides, *caudal* the ulnar and fibular.

These terms, like the others of the series, are employed in a general and comprehensive sense, and are not intended to imply direction to a specific point. Thus when we say that an organ extends cephalad, we do not mean that it can be traced to a particular spot in the head, or even that it reaches as far as the head, but only that its general drift is toward the head. When one of two objects is nearer the head-end and the other nearer the tail-end of the body, the first is cephalad of the other, the second is caudad of the first, and this although both may be as distant as possible from cranium and coccyx. In the tail itself the same relations hold—the third coccygeal vertebra is cephalad of the fourth and caudad of the second. It is easy to see that the position of the animal under examination creates no obstacle to our immediate under-

standing of the idea which it is intended to convey. Having decided which is the head-end, it is as easy to comprehend the description when the body is inverted as when it is in the usual attitude.

*Dorsal* means position in, *dorsad* direction toward, the back, reference being had especially to the cavity which contains the central organs of the nervous system—the neural cavity or canal. Synonymous terms in human anatomy are posterior, back, hind, hinder, neural.

*Ventral* means position in, *ventrad* means direction toward, the great body-cavity containing the digestive organs and the principal organs of the blood-vascular system. Equivalents in human anatomy are anterior, front, fore, visceral, hæmal.

*Dorsal* refers to the extensor side of both the upper and the lower limbs, *ventral* to the flexor side.

The terms *dorsal* and *ventral* are relative—*e. g.*, when one of two objects in the belly is nearer the neural cavity it is *dorsad* of the other and the latter is *ventrad* of it. The terms are general, in that they do not refer to any especial point in the regions concerned.

*Mesal* means position on the *meson*, the imaginary middle plane which divides the body symmetrically into right and left halves, and extends from the dorsal to the ventral surface. The terms median, mesial, medial are synonyms of mesal. *Mesad* means direction toward the meson.

*Lateral*, to which external and outer are often equivalent, means position at one or the other side of the meson—either of the two. *Laterad* means direction away from the meson.

The mesal aspect of a limb is the one which, in its normal position, faces toward the meson; the lateral aspect is that which faces away from the meson.

A part nearer than another to the meson is *mesad* of it; one further away than another is *laterad* of it. As in the cases of cephalic and caudal, dorsal and ventral, the terms are general and comprehensive.

When it is desired to specify which of the two lateral halves is intended, the terms *dextral* and *sinistral* are employed in the same sense as their vernacular equivalents, right and left. *Dextrad* and *sinistrad* signify *toward the right* and *toward the left*, respectively, and are used comprehensively, as when one speaks of moving to the right or left.

*Central* means position in a central organ or system, and is opposed to *peripheral*, which means position away from a central organ or system. In reckoning the teeth, those nearer the meson are central. Direction toward a central part is *centrad*, toward a peripheral part is *peripherad*.

*Proximal* means position near the point of attachment or origin of an appendage, or nearer the attached extremity than is some other part of it. *Distal* indicates position in an appendage away from the attached end.

*Proximad* and *distad* signify respectively direction toward or away from the attached end of a part or appendage. Thus the elbow is proximad of the wrist but distad of the shoulder.

*Etal* (Greek ἐξτός, without) means position on a surface further from a real or supposed centre than some other part with which it is compared. Its equivalents are external, outer, superficial. *Ental* (Greek ἐντός, within) indicates position on a surface nearer to a real or supposed centre than some other part. Inner, internal, deep, profound are its common synonyms.

*Etad* means direction from a point nearer the centre toward a point further from it; *ental* means direction toward a point nearer the centre.

*Afferent* and *efferent* have been employed so long as to need no definition except as far as certain conventional applications are concerned. The basis of their use is physiological rather than anatomical, and one could not tell from structure alone how to apply them. The "carrying to" and "carrying from," which they respectively imply, signify different directions in associated organs, as when two bloodvessels lie side by side, and one is afferent and the other efferent. Afferent bloodvessels (arteries) carry blood *to* an organ; efferent bloodvessels (veins) carry blood *from* an organ. Afferent nerves extend centrad; efferent nerves extend peripherad. Lymph-vessels carrying lymph to a node are afferent; those which take lymph from a node are efferent.

**Historical.** The principles which should guide us in revising the nomenclature having been discussed, let us consider the efforts which have been made in a practical way to effect a reform.

The most important writers on the subject have been Barclay (1803), Owen (1846), and Pye-Smith (1877) in England, and in America, Burt G. Wilder, of Cornell University, who for a quarter of a century has been the leader in this movement. Others have done praiseworthy work, but these four loom up as did Saul among the Israelites. In 1889 the Association of American Anatomists appointed a standing committee on nomenclature, with Joseph Leidy, the foremost anatomist of our country, as its chairman, and adopted a list of terms which though a very small one was notable for including examples of the principal lines of improvement which have been advocated in this paper—single-word terms, precision, compactness, suppression of personal names, and intrinsic terms of location and direction. The subject was discussed at various annual meetings, and in 1897 a long list of terms was adopted and another in 1898. Beside the action of the Anatomists, attention has been paid to the subject by the American Association for the Advancement of Science and the American Neurological Association, the latter giving its support to a large number of terms relating to the nervous system. As yet the field has not been entirely covered, it being thought better to let many

old terms remain undisturbed until something like unanimity as to substitutes can be had.

In Germany a committee of the Anatomische Gesellschaft, after some years of deliberation, presented a report in 1895 which included all departments of the subject and embraced about 4500 terms. It plainly bears the impress of His, who has been the chief mover in the enterprise.

COMPARISON OF THE GERMAN AND AMERICAN REPORTS. The principles actuating the various American societies above mentioned are those herein advocated. Already the agitation of the subject has had a perceptible effect upon medical literature, the most conspicuous evidence of this being found in a large work on diseases of the nervous system, recently published, in which the author uses exclusively the simplified nomenclature.

In the German revision the adoption of Latin as the language of the nomenclature is encouraging, and will lead, I hope, to its general employment in terminology to the exclusion of the perplexing and often uncouth vernacular terms. The complete abolition of personal names is admirable. Some over-long names have been abridged.

But the German work has many and glaring faults. It has failed to shorten long terms, when it could easily and profitably have done so. For instance, where we say *cortex* it uses *substantia corticalis*. It has selected unwisely in some cases from among synonyms, as when it uses *processus vermiformis* instead of *appendix*—a word universally recognized as the basis of the name of the common disease of the organ in question. It is not consistent, sometimes using one word and sometimes another to express the same idea, as *dorsalis* and *posterior*. It has wantonly changed the meaning of terms which have been sanctioned—one may say embalmed—by the long usage of the most learned men—terms from which valuable derivatives have been formed—thus introducing confusion where it should have contributed to clarity. For example, *metencephalon* is shifted from the last encephalic segment to the one immediately cephalad of it.

The Anatomische Gesellschaft revision is excellent just in proportion to its adherence to the principles which have actuated the societies in this country. In its merits it was forestalled by the suggestions of English and American anatomists, who have displayed a better comprehension of the needs of nomenclature and higher qualifications for improving it. In its defects it gives another characteristic illustration of German indifference to outside opinion and lack of appreciation of the work of other nations.

**Objections Answered.** Those who have examined the improved nomenclature but cursorily, and have not taken the trouble to inform themselves concerning the principles which underlie it, have the im-

pression that it is purposed to overturn the terminology to which they have been accustomed and "to create a language entirely new and for the most part strange." One alarmist sees "imminent danger of the formation of a peculiar anatomical vocabulary in America such as seriously to impede scientific intercourse with other countries." Somebody has contemptuously referred to the simplified nomenclature as a "scientific Volapük." But there is little prospect of any such verdict from any unprejudiced person who has looked into the subject judicially. The general drift of adverse criticism has shown how much easier it is to be facetious than it is to be fair. It has been said that Wilder is trying to introduce an artificial language of his own invention; but he has repeatedly pointed out that Barclay, Owen, and Pye-Smith are entitled to the credit of almost all of the novelties which appear in the improved nomenclature, and "that so far from proposing numerous and radical innovations, he has confined himself mainly to crystallizing and formulating ideas already published, and has simply been somewhat more persistent and consistent than others in their advocacy and application."

Wilder has, indeed, suggested a very few absolute innovations, in order to substitute single-word terms for unwieldy polyonyms, and these seem to me to be great improvements. For example, he proposed *porta* for *foramen of Monro*; *aula* for the prosencephalic portion of the third ventricle; *metaporus* for the aperture (porus) in the roof of the metencephalon, commonly called the foramen of Magendie; and several others which space forbids rehearsing. He proposed the suffix *cœle* (*χωλία*, hollow) as a designation of each portion of the general ventricular cavity of the brain, the first part of the technical name of the segments serving to specify the portion of the cavity intended. Thus, as we have *prosencephalon*, *diencephalon*, *mesencephalon*, *epencephalon*, and *metencephalon* (the five acknowledged segments), so we should have as their cavities respectively, *prosocœle*, *diacœle*, *mesocœle*, *epicœle*, and *metacœle*. These certainly are easier to use than *lateral ventricles*, *third ventricle*, *aqueduct of Sylvius*, and *fourth ventricle*, and have the great additional advantage, common to single-word terms, of capability of adjective inflection.

Wilder's suggestions have been mainly in the domain of the anatomy of the brain, to which he has devoted vast study for many years, and whose terminology is admitted on all hands to need revision more urgently than any other region of the body, for it is overloaded with a mass of clumsy and unnecessary words which serve to obstruct rather than to facilitate study.

Changes in nomenclature are constantly occurring and will be made as long as knowledge increases. At no two periods is the nomenclature

the same, as can readily be seen by reference to the best books of the past. A generation ago we learned about "the ventricle of the corpus callosum" and "the labia cerebri," but most text-books use neither term now. We speak of the "iliacus internus" muscle, but how many know that the locative adjective, instead of being superfluous as it is now, was once necessary to distinguish this organ from the "iliacus externus," which we now call "pyriformis." For generations the parasitic "internus" has clung to the noun, and conservatism continues to approve and insist upon it.

Whenever new light is thrown upon any part of our subject and our ignorance is exposed, we do not (if imbued with the true scientific spirit) hesitate to confess our error and adopt the truth. If the names previously used are, with our new knowledge, shown to be so inappropriate as to be misleading or so clumsy as to be insufficient or unserviceable tools, we should not retain them beyond the time when we can invent others enough better to justify the change. As Emerson says: "A classification or nomenclature used by the scholar only as a memorandum of his last lesson in the laws of nature, and confessedly a makeshift, a bivouac for a night, and implying a march and a conquest to-morrow, becomes through indolence a barrack and a prison in which a man sits down immovably and wishes to detain others." Some of the few who seriously oppose the Anglo-American nomenclature (the name suggested by Wilder for the simplified terminology) seem to be hostile to any change whatever. But whether we will or no a new nomenclature will be adopted, gradually, of course, but somewhat radically, in the course of years. How much better that we should do something intelligently to guide as far as possible the tendency of events, to assist fate, as it were, in a desirable direction, than idly to permit our nomenclature to become still more deformed, incongruous, and burdensome, or, far worse, to obstruct well-considered and reasonable efforts at its reformation, to extol its present blemishes and defects, and to defend and advocate methods which will increase still further the difficulties of all future students of our science.

# HYGIENE.

By HENRY B. BAKER, M.D.

**Introductory.** Hygiene may be considered from a purely selfish stand-point—personal hygiene—or from an impersonal stand-point—public hygiene. Self-interest or other cause has induced most persons to be alive to all those advances in knowledge immediately available as guides to personal safety and well-being, so that even though many persons do not habitually act up to the knowledge which they possess, any thorough treatise on personal hygiene must set forth much that is very commonplace to most intelligent persons, and especially to physicians.

Public hygiene is more complex, less easily mastered, and cannot be controlled by an individual; its benefits are seldom appreciated by individual citizens, who, as a rule, therefore, do not study it; the several sciences on which it is based are seldom all so mastered as to be readily brought into effective use in this field of effort. Therefore, public hygiene needs elucidation much more than does personal hygiene, and is, I believe, more generally profitable as well as being a most interesting study.

A glance at the recent mortality tables is instructive in this connection, and shows us that the principal causes of death are due not to ignorance or disobedience of the laws of personal hygiene, but to diseases which no amount or degree of personal hygiene can do much to control, although through general cooperation and governmental control those diseases which cause most deaths are believed to be in great part preventable. Consumption usually heads the list, with pneumonia next—diseases the germs of which are so common that no one person alone can always guard against taking them into the body, and against which many persons cannot withstand, because they are so constituted that they have no resistance. Yet there are now good reasons for the belief that through public measures, easily maintained when once fairly inaugurated, persons susceptible to consumption may at a time not very far in the future be comparatively safe from the “great white plague.” Not only this, but in that “good time coming,” if it shall come, those now least “fitted to survive,” because of their susceptibility to consumption, will probably be best fitted to survive, because of their lack of tendency to gout, rheu-

matism, neuralgia, and all the numerous train of diseases which now cause most sickness, and which lead up to so many premature deaths. In other words, a different type of human beings may prevail if mankind can conquer consumption and the other germ-caused diseases which the body now has to battle with by means of leucocytosis ; and longevity will be increased not only by reason of the decrease of premature deaths due directly to those diseases, but also by reason of perhaps an equal number of lives indirectly saved, for a considerable time, from those diseases which result from the reactions of the body to those germ-enemies—such reactions as the leucocytosis—which, I believe, not infrequently terminate in arthritis, pericarditis, endocarditis, arterio-sclerosis and the general formation throughout the body of what is no better than, and some of which may be termed, scar tissue, which prematurely constitutes old age and leads to premature death.

Stated thus briefly, in advance of the presentation of evidences of recent progress on which the views are in part based, and stated for the purpose of serving as a thread which may aid in following the trend of some of the evidences and considerations to be presented, it is hoped that the statements in the foregoing paragraph, if not accepted, may be held as hypotheses pending investigation.

One duty of persons engaged in public health work is, from time to time, to survey the results gained in the several medical and other sciences which contribute to the sanitary sciences, group together the new facts and compare them with the old ones, interpreting for sanitary purposes the same series of facts which have been considered by physicians for therapeutic purposes ; noting what accepted doctrines are destroyed and what are sustained ; and, where positive knowledge is not yet perfected, framing hypotheses which shall serve a temporary yet useful service, even if in no other way than by supplying a definite view, which can then readily be overthrown or established by the collection of further facts.

### **RELATIVE AMOUNT OF SICKNESS FROM DIFFERENT DISEASES.**

Very few States have sickness statistics. Perhaps those of Michigan are likely to be as generally representative as those of any Northern State, and I know of none in any Southern State. The sickness statistics of Michigan are based on weekly reports by representative physicians in active general practice in different parts of the State. For the thirteen years, 1885 to 1897, the principal diseases as causes of sickness, arranged in order with those most prevalent first, judging from the "percentage of reports," which stated the presence of each of the diseases



in connection with the reported "order of prevalence," when and where each disease was present, were as follows :

DISEASES IN MICHIGAN, 1885-1897, ARRANGED IN ORDER OF PREVALENCE, THOSE WHICH CAUSED MOST SICKNESS BEING PLACED FIRST.

- |                             |                                |
|-----------------------------|--------------------------------|
| 1. Rheumatism.              | 15. Measles.                   |
| 2. Neuralgia.               | 16. Cholera infantum.          |
| 3. Bronchitis.              | 17. Erysipelas.                |
| 4. Influenza.               | 18. Typho-malarial fever.      |
| 5. Diarrhoea.               | 19. Pleuritis.                 |
| 6. Tonsillitis.             | 20. Scarlet fever.             |
| 7. Intermittent fever.      | 21. Typhoid fever (enteric).   |
| 8. Consumption, pulmonary.  | 22. Inflammation of bowels.    |
| 9. Remittent fever.         | 23. Diphtheria.                |
| 10. Pneumonia.              | 24. Puerperal fever.           |
| 11. Whooping-cough.         | 25. Membranous croup.          |
| 12. Cholera morbus.         | 26. Smallpox.                  |
| 13. Dysentery.              | 27. Inflammation of brain.     |
| 14. Inflammation of kidney. | 28. Cerebro-spinal meningitis. |

### NEURALGIA, GOUT AND RHEUMATISM.

Inasmuch as rheumatism is alleged to be the cause of more sickness than any other disease, and neuralgia the disease which causes the next most sickness, it is plain that it is more important to learn their causation than that of most other diseases, except those which cause most deaths, and the modes of causation in the majority of these have already been worked out.

Throughout the greater portion of the United States the popular term for all the conditions of pain and swelling about joints is rheumatism, and this term is used relative to pain and stiffness in tendons and muscles. Occasionally, in a particularly aristocratic person whose style of living is in harmony with the idea of gout, that term is used in cases having the characteristics which have been associated with the idea of gout.

Text-book definitions and descriptions suggest either an identity or a similarity of the main causes of the conditions which are named gout and rheumatism.

Sickness statistics in Michigan indicate that what the physicians report as rheumatism is a disease which has a well-marked course in fixed relations with the principal meteorological conditions. The statistics indicate, also, that what the physicians call rheumatism has very close similarity in time and in amount to what these same physicians report as neuralgia.<sup>1</sup>

Considering the alleged cause of gout and rheumatism and all of the evidence now apparent, it seems reasonable to form the provisional

<sup>1</sup> Annual Report of Michigan State Board of Health, 1897, p. 129, plate 917; also plate (1006) in this article.

hypothesis that the principal causes of neuralgia, gout, and rheumatism are the same, and that leucocytosis and hyperinosis are important factors in the causation; and considering the anatomical structure of the sites of these three sorts of pain, it is easy to believe that the destruction of the white blood-cells, that yield the offending, insoluble uric acid or allied substances, is frequently, perhaps usually, in the exact site of the pain—that is, in gout not infrequently around the metatarso-phalangeal joint of the great toe; in rheumatism, around some joint or in the sheath of a muscle; in neuralgia, in the fibrous tissue about a nerve. All of these situations, and others which are easily recalled to mind, are such as supply the ideal conditions for the final lodgement of white blood-cells, which, under conditions of sluggish circulation, influence of cold, toxins, etc., cannot possibly go further. Like some of the higher forms of life, they may fall by the wayside and block the way of others which but for the obstruction might pass on in safety.

The observations of physicians and patients have established the common belief that gout is aggravated and sometimes brought on by certain kinds of food, especially in excess. That the kinds of food which do this are not the same for all persons does not seem strange when we reflect that it is probable that the results of digestion of some kinds of food are not the same in all persons.

The apparent relation of cause and effect between the partaking of certain kinds of food or drink and the onset of gout has been so prompt that it has been easy to believe that some direct product of the food has reached the seat of the pain. Within recent times it has come to be believed that the uric acid, which is alleged to be the irritant substance, is not directly dependent upon the kind of food. "The amount of urea in the urine is directly due to the kind and quantity of the food, but the quantity of uric acid is dependent wholly upon tissue consumption."<sup>1</sup>

But the increase in the leucocytes follows so promptly the ingestion of certain kinds of food, and their destruction may occur so promptly, that it would seem to make little difference whether uric acid is formed from the food directly or indirectly by the destruction of the leucocytes.

It being proved, according to Delezené, that the leucocytes are destroyed in the circulation by Witte's peptone, by such soluble ferments as diastase, and by bacterial toxins, and it being apparent that the leucocytes are increased by injection or ingestion of certain substances rich in nuclein or in nuclein-forming material, it would seem to be plain that any substance such as uric acid, which is alleged to be formed by the destruction of the leucocytes or of nuclein, may be abnormally produced by the combination of the two conditions—that is, by the ingestion of

<sup>1</sup> PROGRESSIVE MEDICINE, June, 1899, p. 347.

nucleins, albumins, etc., followed by the presence of a soluble ferment, a peptone, or a bacterial toxin, such as may be derived from the pneumococcus in the air-passages or from the gonococcus in the urethra, or, perhaps, by finding such a substance in some part of the body. "The largest part of the albumin ingested in the food is converted into peptones; these, however, are not absorbed as such but are reconverted into albumins in the gastro-intestinal mucosa. Only a small quantity of peptone passes into the blood."<sup>1</sup> But is it not true that the more albumin ingested the more peptone passes into the blood? May it not follow that the more albumin ingested the greater the formation, and subsequently the greater the destruction of the leucocytes the greater the formation of uric acid and allied substances, and the greater the tendency to gout? If such are the facts they harmonize with the experiences and observations of innumerable patients and physicians.

**Leucocytosis Caused by Micro-organisms.** Through the labors of Metschnikoff and many others it has come to be understood that in the battle with some micro-organisms there is formed in the body an unusual number of white blood-cells. This fact, put with the fact that uric acid is formed by the breaking down of the nuclein of the white blood-cells, and with the fact that uric acid is the apparent cause of gout, has led to the belief that gout is a result of the reaction of the body to certain microscopical causes of disease. If this is true, then gout should be most prevalent just following the greatest prevalence of those diseases which tend to produce leucocytosis and subsequent destruction of leucocytes. It seems to be generally true that leucocytosis results from *successful* reaction to micro-organisms which enter the circulation; also, that the white blood-cells are destroyed by the toxins formed by pathogenic micro-organisms. If the fibrin in the blood is formed by the destruction of the white blood-cells by the toxin of pathogenic micro-organisms,<sup>2</sup> then some of the diseases which should be followed by gout in point of time (but not necessarily in the same person, because leucocytosis results from successful resistance of the body to the invading micro-organisms) are tonsillitis, influenza, bronchitis, and pneumonia. On this point the writer has collected some statistical evidences which seem important enough to be considered in connection with facts from other sources, and which, therefore, are here mentioned. Rheumatism is not the immediate cause of death in such a large number of instances that the mortality statistics are useful for studying the times of greatest and least prevalence of the disease. In Michigan, however, sickness statistics

<sup>1</sup> Gould's Dictionary, word "peptone."

<sup>2</sup> Mathews. *Journal of Boston Society of the Medical Sciences*, June, 1899; *Journal of American Medical Association*, July 22, 1899, p. 216. Delezenne; referred to in *PROGRESSIVE MEDICINE*, June, 1899, pp. 267, 268.

have been collected for many years, and they enable one to know at what season of the year rheumatism is most prevalent and at what season it is least so. These statistics show that sickness from rheumatism is most prevalent in April and least in August. It is apparent, therefore, that the disease is most prevalent soon after the time of greatest prevalence of influenza, tonsillitis, bronchitis, and pneumonia—diseases the specific causes of which enter by way of the air-passages. Rheumatism is least prevalent at the time of the diarrhoeal and other diseases, the germs of which enter the alimentary canal.

This evidence tends to show that the toxins formed in the intestinal diseases do not tend directly or indirectly toward rheumatism, or if they do, that there are still more powerful influences in the other direction. If the toxins are acid the normal alkalies in the intestines may neutralize them. At any rate, there is least rheumatism in August, when the intestinal diseases culminate, and coincidently with the decline of the intestinal diseases rheumatism increases—in fact, the curve representing the seasonal rise and fall of rheumatism is almost precisely the reverse of the curve representing the seasonal rise and fall of diarrhoea, cholera infantum, and cholera morbus. It is as if the acute intestinal diseases just mentioned are in some way preventive of rheumatism (Fig. 48).

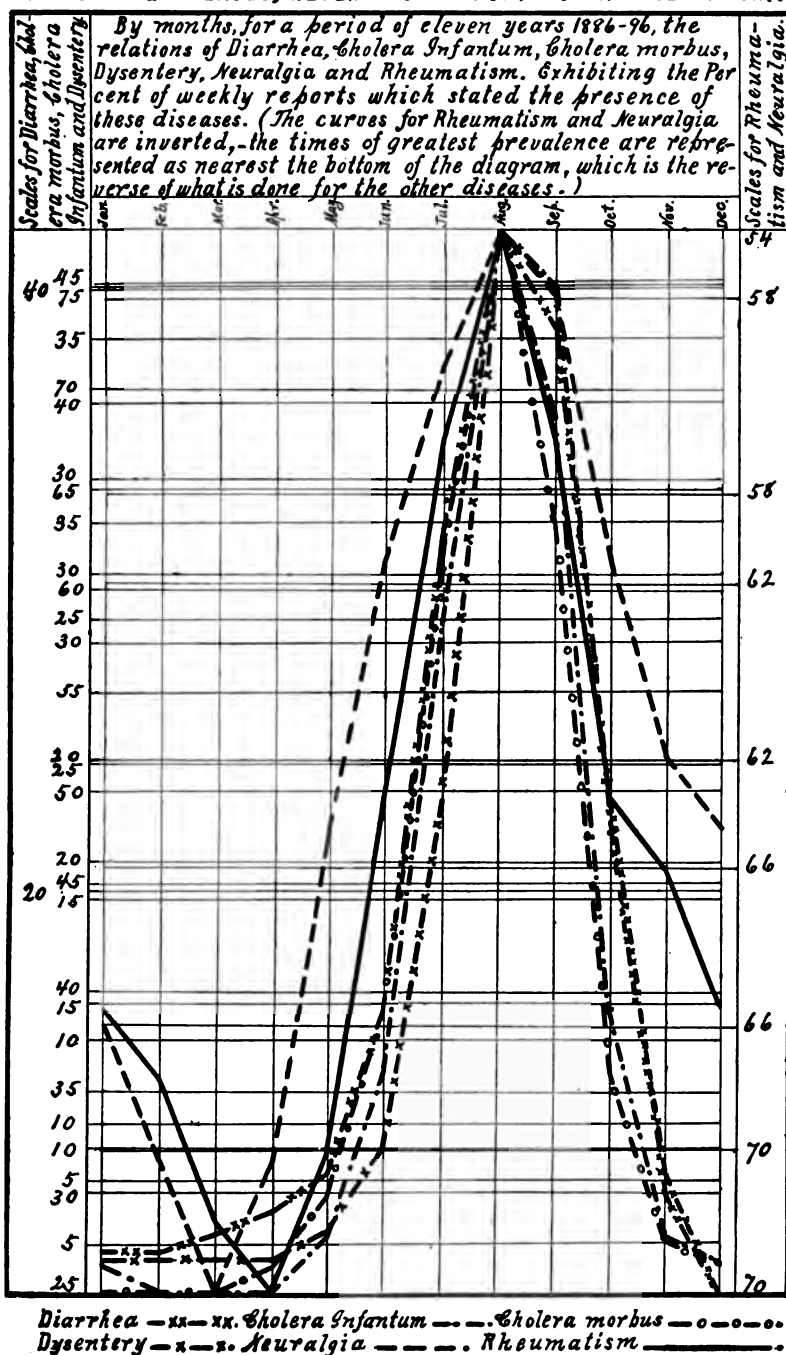
Another explanation may be that the rheumatism is not so frequent in summer, because the diseases which enter the body by way of the air-passages are not so common at this time of the year.

According to accepted doctrines, it has been supposed that irritations of a mucous membrane by pathogenic bacteria cause to pass to that surface greatly increased numbers of leucocytes. Possibly greatly increased numbers do not go there, but decreased numbers return, and this may greatly reduce the number in the general circulation. In the intestines any leucocytes and products of destruction of leucocytes are likely to pass out of the body because of the diarrhoea. In the lungs and air-passages, unless coughed out, they remain. If rheumatism is caused by uric acid or other substance formed by the breaking down of the white blood-cells, and in the intestinal inflammations the leucocytes tend to pass out of the body, rheumatism should be, *as it is*, generally decreased during the general increase of the diarrhoeal intestinal diseases, and generally increased, *as it is*, after the prevalence of such diseases as pneumonia, in which there is great accumulation of fibrin in the general circulation—probably the remains of the leucocytes (and comparatively few other corpuscles) which met with destruction in their “battle” with the pneumococci or their toxin, and some of which, during and following the prevalence of pneumonia, are absorbed into the general circulation.

Whether or not those micro-organisms which cause the diseases in the air-passages enter into the general circulation more or less generally than

FIG. 48.

## INTESTINAL DISEASES, REVERSE OF RHEUMATISM AND NEURALGIA.



do those pathogenic in the intestines, and thus tend, more or less, than do those in the intestines, to cause leucocytosis and consequent rheumatism, is a question for the bacteriologists to answer.

Whether the toxins formed in the lungs and air-passages are absorbed into the general circulation, where they can destroy blood-cells, more generally than are those toxins formed in the intestines, is a question which ought to be answered by the physiological chemists; and that are so absorbed is probable, since diarrhoea is so common in intestinal diseases, and, therefore, the tonics are eliminated.

It appears to have been proved by Horbaczewski<sup>1</sup> that defective oxidation of nuclein results in the formation of the xanthin bodies. "They are basic substances readily soluble in water."<sup>2</sup> Then the permanent accumulations in rheumatism and gout cannot be due to defective oxidation of nuclein in the general circulation, because a very soluble substance would readily pass out of the body, either by way of the kidneys or the intestine, and, therefore, could not accumulate in the fibrous tissues. Beside, the accumulations have been proved by analyses to be urates, and biurates which are still more insoluble than the urates.<sup>3</sup>

Rheumatism is not most frequent but least frequent during and following the heat of summer, when the atmospheric ozone is at its minimum, and when, because of the expansive influence of heat, the atmosphere is least condensed; therefore, the least oxygen-containing air is inhaled.

Probably, however, as there is then most sickness from diarrhoea and other diseases of the intestines, the "basic substances readily soluble in water"—the xanthin bases formed by the imperfect oxidation of nuclein—pass out of the body by way of the intestines.

And at such times, as diarrhoeal diseases prevail, destruction of the white blood-cells, to supply the nuclein to be imperfectly oxidized into basic soluble substances, probably occurs in the intestinal tract, where the results of the nuclein oxidation may best be excreted, because destruction of the white blood-cells is caused by the toxins due to the micro-organisms.<sup>4</sup>

**One Possible Reason Why there is Most Intestinal Disease in the Heat of Summer.** The fact that there is most intestinal disease in the heat of summer, when there is least rheumatism, suggests the question as to how much of the intestinal disease is due to the xanthin bodies,

<sup>1</sup> Wiener Academieberichte, 1889.

<sup>2</sup> Journal of American Medical Association, July 8, 1899, p. 60.

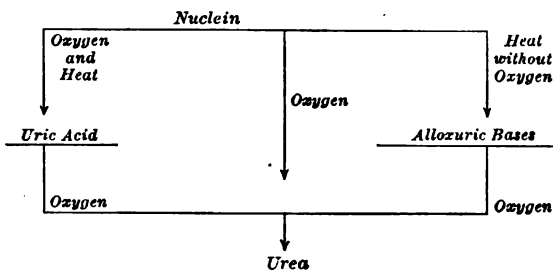
<sup>3</sup> A. P. Luff. London Lancet, March 27, 1897; April 17, 1897, p. 1069, and June 11, 1898.

<sup>4</sup> Mathews. Journal of Boston Society of the Medical Sciences, June, 1899; Journal of American Medical Association, July 22, 1899, p. 216. Delezenne; mentioned in PROGRESSIVE MEDICINE, June, 1899, pp. 267, 268.

or, as recently called, "alloxuric bases,"<sup>1</sup> which are formed by the imperfect oxidization of nuclein. If oxidized into urea the alloxuric bases would readily and harmlessly pass out of the body by way of the kidneys; but Gaucher, Kolisch and Tandler, and Croftan having shown that the xanthin bodies cause epithelial nephritis when excreted by way of the kidneys, it seems reasonable to suspect that if excreted by way of the intestines they may cause diarrhoea and other derangements due to irritation of the intestinal epithelium.

A diagram offered by Dr. Croftan, to illustrate the relationships of nuclein, oxygen, alloxuric bases, uric acid, and urea, is suggestive when considered in connection with diagrams exhibiting the relationships of rheumatism and the intestinal diseases (Fig. 49), and with two facts established by the Michigan sickness statistics: "The more atmospheric ozone the more rheumatism," and "the less atmospheric ozone the more intestinal disease." Dr. Croftan's<sup>2</sup> diagram is as follows:

FIG. 49.



**Why Do Not Rheumatism and Neuralgia Prevail More Frequently in December, January, and February?** The foregoing diagram may help to explain why, as, shown by the table (Fig. 48), there is in the winter months a slight departure from the uniformity which exists in all other months of the year. The table also (Fig. 48) shows that while in other months rheumatism and neuralgia are quantitatively the reverse of the intestinal diseases, in the coldest months there is less rheumatism and neuralgia than there should be in order to be quantitatively the reverse of the intestinal diseases. This should be true, as it is, if in the coldest months the air inhaled, being very condensed and containing much ozone, is able to oxidize into harmless urea the excess of uric acid formed by the partial oxidization of nuclein which results from the excessive destruction of white blood-cells, this in turn being caused by the toxins of the micro-organisms of diseases of the throat and air-passages.

<sup>1</sup> Journal of American Medical Association, July 8, 1899, pp. 60, 61; also (for an excellent presentation of the subject) *ibid.*, July 31, 1897, pp. 216-221.

<sup>2</sup> *Ibid.*, July 1899, p. 60.

**The Relation of Rheumatism to Inflammation of the Kidney.** "As early as 1884, Gaucher<sup>1</sup> discovered that the injection into the body of a healthy animal of small quantities of xanthin and hypoxanthin—both belonging to the group of alloxuric bodies—produces marked changes in the excreting cells of the kidney parenchyma—néphrite epithéliale. Kolisch and Tandler<sup>2</sup> also made this observation. My own investigations, recently completed and not yet published, made with a view of corroborating these findings, positively demonstrate that both xanthin and hypoxanthin, when injected hypodermatically in the strength of a 0.3 to 0.7 per cent. watery solution for a period of several months, produce granular degeneration of the epithelial cells lining the tubuli contorti and a proliferation of the endothelium of the intertubular capillaries. Albumin was invariably found after a period of three weeks. We may say, therefore, that the presence of minute quantities of alloxuric bases in the circulation is capable of producing marked anatomical kidney changes."<sup>3</sup>

The foregoing being true, it follows that so far as inflammation of the kidney is caused by the xanthin bodies, that disease should be most prevalent when those bodies are most formed in the body—namely, when the nucleins in the body are least perfectly oxidized. Atmospheric ozone is least abundant in summer; and as the air is most expanded in summer, tissue or at least blood oxidization is then most defective for that reason also.

What answer do sickness statistics give to the question, When is there most sickness from inflammation of the kidney? The statistics prove that it follows a half-month or a month later than the rheumatism.

The diagram (Fig. 50) shows that inflammation of the kidney commences to increase in October—one month later than rheumatism commences; and it continues to increase until April, the same month in which rheumatism reaches its maximum; but it continues prevalent in May, declining one month after rheumatism has declined.

This tends to prove that whatever causes that sickness which is reported as rheumatism, which term probably includes gout, also causes, later on, recognizable inflammation of the kidney.

This does not support the views of Levison,<sup>4</sup> Kolisch<sup>5</sup> and others that "granular atrophy of the kidney is a constant precursor of gout,"<sup>6</sup> or that "graver manifestations of gout only make their appearance when

<sup>1</sup> *Revue de Méd.*, 1888; *Pathogénie de Néphrites*, Paris, 1886.

<sup>2</sup> *Monograph* Stuttgart, 1895.

<sup>3</sup> Croftan. *Journal of American Medical Association*, July 8, 1899, pp. 60, 61.

<sup>4</sup> *Zeitschrift für klinische Medizin*, vol. xxvi.

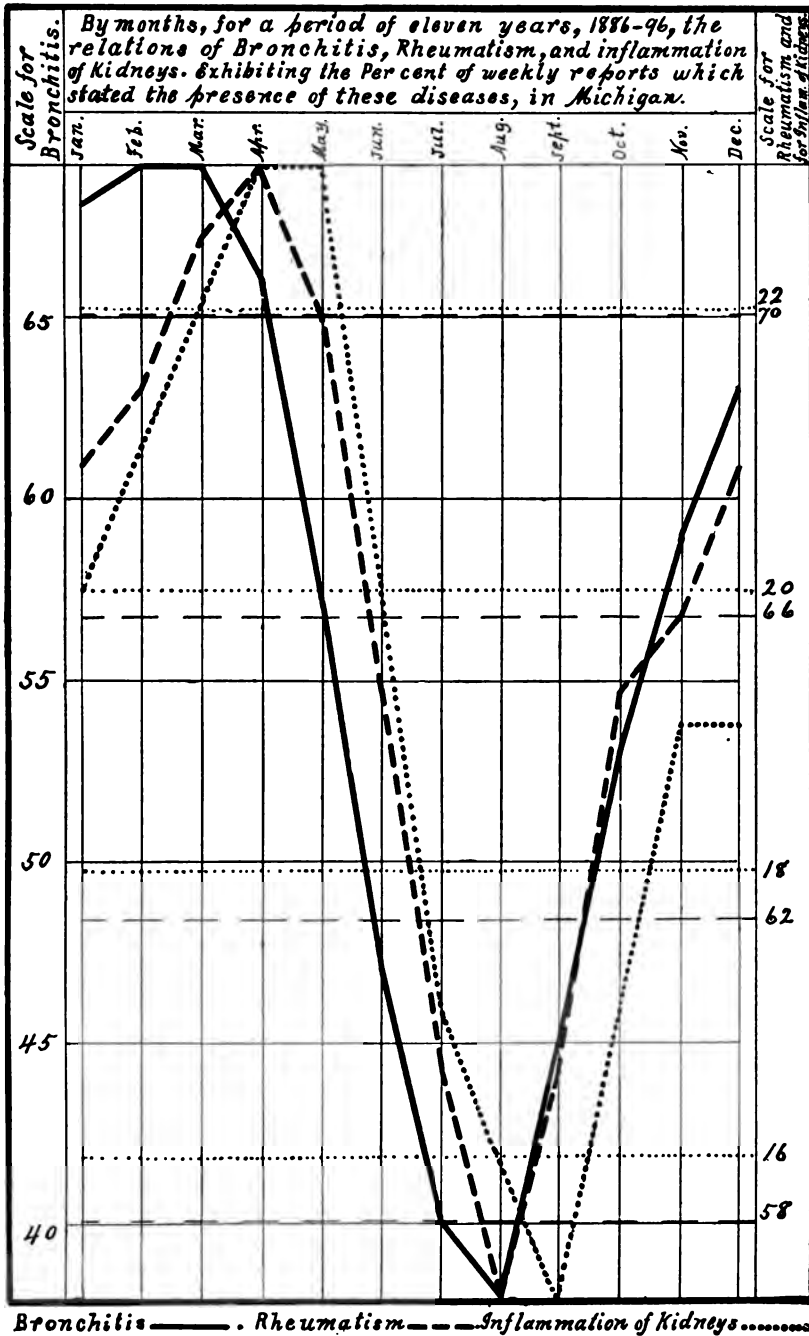
<sup>5</sup> *Wiener klinische Wochenschrift*, 1895.

<sup>6</sup> *Journal of American Medical Association*, July 8, 1899.



FIG. 50.

DIAGRAM.—RHEUMATISM FOLLOWS BRONCHITIS, INFLAMMATION OF KIDNEYS FOLLOWS RHEUMATISM.



the functions of the kidney become impaired from any cause,"<sup>1</sup> although it does suggest that gout or rheumatism is a precursor of inflammation of the kidney. In fact, this is conclusively proved by the Michigan sickness statistics, of which the diagram (Fig. 50) is an illustration. The evidence does not support the view that either rheumatism or inflammation of the kidney is caused by defective oxidation in the general circulation, because both diseases are more than usually prevalent in months when there is more atmospheric ozone than usual and when the atmosphere is colder and more condensed than usual.

**Local Destruction of Nuclei and Formation of Alloxuric Bases Suggested.** The reasons why the prevalence of rheumatism is coexistent with excessive atmospheric ozone, notwithstanding it is caused by imperfect oxidization of nuclein, are probably as follows :

The infectious diseases of the throat, air-passages, and lungs are all increased during and immediately following the time of greatest coldness of the atmosphere—a time of excessive prevalence of ozone and the other throat irritants. The red blood-cells are the carriers of oxygen, and they do not go into the cartilages and white fibrous tissues where rheumatism has its seat.

If through the destruction of white blood-cells by the toxins of the infectious diseases large numbers of the nuclei of those cells are liberated and carried with the blood-serum into the lymph-spaces, cartilage, and white fibrous tissue, where they accumulate, their oxidization *there* must necessarily be imperfect, in which case, according to the latest evidence, xanthin bodies must be formed ; thus the rheumatism is accounted for through local conditions. "We have no positive knowledge that the alloxuric bases are capable of producing these inflammatory and necrotic changes in the synovial membranes, but we do know that some substances other than uric acid must produce them before urate deposits occur (Levison), and we know, further, that alloxuric bases do produce the kidney changes, following which analogous urate deposits occur in those organs ; the assumption, therefore, that they are responsible for the joint lesions, too, is very probable."<sup>2</sup>

**Diet an Insufficient Preventive of Rheumatism and Gout.** If rheumatism follows the diseases of the air-passages because of successful resistance to the specific causes of those diseases, no change in diet is likely to greatly lessen rheumatism without greatly lessening the natural defences of the body against the diseases of the air-passages ; therefore, the importance of measures for the lessening of the specific causes of the diseases of the air-passages is most amazingly intensified.

<sup>1</sup> Fletcher. Journal of American Medical Association, July 31, 1897.

<sup>2</sup> Croftan. Ibid., July 8, 1899.

Of themselves, the diseases of the air-passages cause most deaths ; if, in addition, they are the indirect cause of rheumatism and neuralgia—those diseases which cause most sickness, and which also lead to diseases of the heart and bloodvessels that result in a considerable proportion of the total mortality—the tremendous importance of restricting the diseases of the air-passages becomes apparent.

### WHAT DETERMINES THE SEAT OF A DISEASE AND ITS SPECIFIC NATURE ?

What determines whether a given micro-organism shall lodge and reproduce itself in the lungs, in some joint, or in the brain or spinal cord, is an interesting question in etiology.

There is conclusive evidence that when the pneumococcus is in the upper air-passages exposure to cold tends to cause pneumonia. The evidence that it is in some way caused by exposure to cold is of three kinds—experimental, clinical, and statistical. Many years ago Platania<sup>1</sup> produced pneumonia experimentally by exposing animals to cold and supplying the specific cause. From time immemorial it has been a common clinical observation that exposure to cold has been a frequent cause of pneumonia. The writer has demonstrated by abundant statistics that in given places pneumonia is quantitatively related to the temperature of the atmosphere.<sup>2</sup> Although it is difficult to prove that this is because of the *inhalation* of cold air the writer believes it to be true.

How the inhalation of cold air makes it possible for the pneumococcus to pass down into the bronchial tubes to the air-cells has not yet been experimentally proved, but it is reasonable to suppose that it may be through partial paralysis of the cilia, which normally tend to carry up, to be coughed out, any dust or particular substance which may gain entrance. Other explanations are plausible and have been suggested.<sup>3</sup>

It has been suggested that the explanation of the fact that cerebro-spinal meningitis not infrequently follows such exposures to cold as falling into the water, and such shocks to the nervous system as exposure to cold after a hot bath or changing from heavy to light clothing, is that the general muscular tension throughout the body, brought about by such impression on the nervous system, causes unusual pressure in those bloodvessels of the brain and spinal cord which have not as thick walls as have those in other parts of the body, and that this tends to cause exudation there

<sup>1</sup> Bulletin Générale de Thérapeutique, Paris, France, December 15, 1889, p. 522; Report of Secretary of Michigan State Board of Health, 1894, p. 204.

<sup>2</sup> The Causation of Pneumonia. Annual Report of Michigan State Board of Health, 1886.

<sup>3</sup> The Causation of Influenza, etc. Annual Report of Michigan State Board of Health, 1894, pp. 172, 179.

with the liberation of any micro-organisms which may be in the blood, capable of causing inflammation in the exudation thus induced. Thus whether as a result of such an experience a person shall have tubercular meningitis, pneumococcus meningitis, diplococcus meningitis, or some other specific inflammation of the meninges, depends upon which one of those species, if any, is present in the general circulation.

## **THE PREVENTION OF DISEASE BY THE REGULATION OF SPITTING.**

How to restrict the diseases of the air-passages has gradually become plain. It remains for those engaged in public health administration to obtain the cooperation of the people and to carry out practically what the several sanitary sciences have evolved.

Bacteriology has given us reasonably exact knowledge of most of the pathogenic micro-organisms which cause the diseases of the air-passages.

Knowledge has come to us from many sources, some of them unexpected. Nansen's journey toward the North Pole yielded the information that outside of inhabited countries it is impossible to "take cold." Vital statistics had long since shown that density of population—proximity of persons—increases the mortality rate from communicable diseases.

Disinfectants have been found, so that the way seems clear for mankind to begin a war of extermination on the pathogenic micro-organisms.

So long as the breeding-places of the germs of the diseases were not known, and the air was supposed to be full of them at all times, there was not much hope for their extermination. Now that we know that those which attack us by way of the air-passages are in great part bred in and spread from the air-passages, or at least from what goes out of the nose and mouth, it begins to look as if a great part of the work of their restriction and prevention will have been accomplished when mankind shall have been taught to promptly destroy or disinfect whatever shall come out of the nose and mouth.

The great sanitary movement of the present time is that for the destruction or disinfection of all sputa.

A coming sanitary movement of importance may be the more prompt disinfection of pocket-handkerchiefs.

The list of diseases likely to be greatly and immediately lessened by these measures is a very long one, and includes most of the very fatal diseases and the greater portion of those which cause the most sickness.

There is even reason to believe that the average age of those reported as having died of "old age" will be greater if the battles for life, that

now recur each winter against diseases which enter by way of the air-passages, can be made less frequent and against lessened combinations of different species of pathogenic micro-organisms.

### PNEUMONIA.

Although no marked new discoveries relative to the causation or the restriction of pneumonia have recently occurred, it is one of the most important subjects in hygiene, because it usually endangers life more than does any other disease except consumption, and since consumption is being decreased, pneumonia is likely soon to be the leading cause of death ; indeed, it is reported to have caused more deaths than did any other disease in Michigan in 1898.

The present status of the knowledge of the causation of pneumonia is such that leading boards of health which aim to promote the public welfare by a system of education of the people in the causation and best measures for the restriction and prevention of the most dangerous diseases, cannot much longer afford to neglect to teach the people how to restrict pneumonia. Realizing this, the Michigan State Board of Health has recently directed the preparation of a statement of the principal facts now known relative to pneumonia and its modes of spreading, with suggestions for its restriction.

The micro-organisms which are the specific causes of the disease are now so well known that it would seem that it is time to class pneumonia among the dangerous communicable diseases, and to enter upon the work for its restriction.

### YELLOW FEVER.

Although to the greater portion of this country yellow fever is of comparatively small consequence, especially when the total mortality from it is compared with the 140,000 deaths per year from consumption in the United States, yet to the Gulf States yellow fever is an important disease to be considered in any thorough summary of disease prevention.

How important the disease appears to those who are officially charged with guarding the lives of the people of a great State can hardly be realized by persons in the extreme northern portion of the country, except by scanning the accounts of the excellent work done by those officials.

In the *New Orleans Medical and Surgical Journal* for July, 1899, is an article by Edmond Souchon, the President of the Louisiana State Board of Health, entitled "Principles of Modern Scientific Sanitation and of Modern Scientific Quarantine," which, however, is confined

to the single disease yellow fever and to measures for its restriction. The point is emphasized that yellow fever develops within five days after exposure to the germs; therefore, quarantine or isolation need not extend beyond that length of time after disinfection. "Isolation, although a valuable adjuvant, is not absolutely necessary. *The sheet-anchor is disinfection*—that is, the destruction of the germs as fast as they leave the body of the patient through the excretions of all sorts, and before they turn into dust and infect the room, then the house and then the neighborhood. All that comes in contact with the patient—fingers, hands, persons, objects—must also be immediately disinfected. The room is the true battlefield. The fight must be made and won in it. The recognition of the first case is the keystone of scientific sanitation. It is, therefore, of the utmost importance that it should be at once reported, even if only suspicious in character."<sup>1</sup>

### TYPHOID FEVER.

**Modes by which Typhoid Fever is Spread.** THE BACILLUS TYPHOSUS IN THE URINE. A very important addition has been made to our knowledge of the source of public danger in typhoid fever by recent researches verifying and perfecting the evidence that the bacillus of typhoid fever is present in the urine in a considerable proportion of the cases which occur, different investigators finding it in a slightly different proportion of the cases examined, but leaving it probable that in about one-fourth or more of the cases the urine contains the germs of the disease in very great numbers, in some cases the urine being a pure culture of the germ.

The importance of this knowledge for public health purposes is very great. It enforces the disinfection of the urine of all typhoid patients, and of their shirts, underwear, pantaloons, and sheets.<sup>2</sup> It explains, at once, those numerous instances of persons attending typhoid patients who contract the disease notwithstanding that every possible care has been taken to avoid eating food or drinking water that could be infected, and every possible care of the discharges from the bowels. The fact that slight drying does not always destroy the germs, and that the urine may be turbid with them, explains how a few drops on the linen of a patient may readily be the means of spreading the disease.

This discovery was made as long ago as 1886, and in 1895, Drs. Wright and Semple<sup>3</sup> published accounts of their experiments. They

<sup>1</sup> Page 3 of reprint of Dr. Souchon's paper.

<sup>2</sup> Dr. Kober, in Report of Health Officer of District of Columbia, 1895, p. 259.

<sup>3</sup> London Lancet, July-December, 1895, pp. 196-199.

found the typhoid bacillus in six out of seven cases of typhoid fever. "In some cases the urine, even before incubation, is absolutely turbid with typhoid bacilli."<sup>1</sup> But it is mainly since Dr. P. Horton Smith's<sup>2</sup> paper that attention has been attracted to the subject among English-speaking peoples. Methods of distinguishing the typhoid bacillus from other micro-organisms have been so improved that the evidence now is conclusive.

An instance of a case of typhoid fever caused by the accidental swallowing, by a nurse, of a small quantity of urine of a typhoid patient is on record.<sup>3</sup> Although vomiting followed, yet she developed typhoid fever after an incubation period of twelve days.<sup>4</sup>

THE TYPHOID BACILLUS IN THE BLADDER FOR YEARS WITHOUT THE FEVER. How typhoid fever may be widely spread, by a person who has not the fever and yet who is daily scattering the germs for a period of three years, may be learned from a report "On a Case of Cystitis of Three Years' Duration Due to the Typhoid Bacillus," by Thomas Houston.<sup>5</sup> The details of the history of this case (following the nursing of two children who died, possibly of typhoid fever), of the bacteriological identification of the bacillus, of the absence of typhoid fever, yet of the occurrence of Widal's reaction and of the evidence of the persistence of the typhoid bacillus in the bladder for three years, are well worked out and reported.

Mr. Houston refers to "Cases in which abscesses containing typhoid bacilli have been observed six or seven years after the occurrence of typhoid fever in the patient."<sup>6</sup>

An abscess is not likely to spread the disease until opened; but a case of cystitis which scatters the typhoid bacilli for years is a serious menace to the public health.

Richardson<sup>7</sup> refers to a remarkable case, mentioned by Dr. Cushing, of Baltimore, of a man who had an attack of typhoid fever five years before. Ever since then there had been trouble with the urine, and investigation showed that there was cystitis present, with the typhoid bacillus in pure culture in the urine.<sup>8</sup>

These cases may be exceptional, but they suggest two important lessons in public health administration:

<sup>1</sup> London Lancet, July-December, 1895, p. 199.

<sup>2</sup> Abstracted in British Medical Journal, February 13, 1897, and London Lancet, February 13, 1897.

<sup>3</sup> Centralblatt für Bakteriologie, 1898, vol. xxxiii., p. 580. Petruschky. Philadelphia Medical Journal, May 28, 1898.

<sup>4</sup> New York Medical Journal, June 25, 1898.

<sup>5</sup> British Medical Journal, January 14, 1899.

<sup>6</sup> Flexner. Journal of Pathology and Bacteriology, vol. iii.

<sup>7</sup> Journal of Experimental Medicine, 1899, vol. iv.

<sup>8</sup> Journal of American Medical Association, March 18, 1899.

Until such time as there shall be general recognition of such cases of infectious cystitis, and thorough measures taken to disinfect the urine, clothing, and persons of such patients, public urinals and public privies should be considered as probably infected with the typhoid bacilli, and action should be taken in accordance therewith. Private urinals and privies must be considered as liable to be thus infected even though no case of typhoid fever has had access to them.

"Richardson<sup>1</sup> dwells particularly upon the value of urotropin as a urinary antiseptic, with especial reference to its use in typhoid fever. Nine cases were treated with urotropin, and in every one the bacilli promptly disappeared. This favorable result was accomplished in eight out of nine cases by the use of 60 grains or less of the drug; one case required 200 grains to remove the organism. Freshly passed turbid urine, if acid in reaction, should always be regarded with suspicion when it is from typhoid patients or convalescents. When such urine, on microscopical examination, shows the presence of bacilli it is probable they are the typhoid bacilli, and the result of the cultures can thus be foretold."

"From the foregoing considerations it may be concluded that inasmuch as the urine of typhoid fever patients may contain typhoid bacilli in enormous numbers for weeks, months, and even years, and thus constitute a grave danger not only to the patients but also to the public health, the necessity for rigid disinfection and supervision of their urine is at once apparent. It would, therefore, seem advisable that, as it is impossible without bacteriological examination to determine whether or not typhoid bacilli are present in a given urine, all typhoid patients should receive urotropin (30 grains daily for ten days), beginning as convalescence is approached. In the struggle in which the profession of the United States is engaged against typhoid fever, such observations as are here referred to are certainly of the greatest importance. They point the way along which the practising physician may do his full duty in his attempts to arrest the spread of the disease when once established."<sup>2</sup>

**THE SPREAD OF TYPHOID FEVER BY FLIES.** The extensive prevalence of typhoid fever in the United States armies during the recent war with Spain, notwithstanding the great increase of knowledge respecting the causation of the disease since the last preceding war, has led to very thorough investigations into the causes of such prevalence. The report of the committee appointed by the Surgeon-General of the War Department of the United States has not yet been made public, but preliminary statements have been made which indicate that the report

<sup>1</sup> *Journal of Experimental Medicine*, 1899, vol. iv.

<sup>2</sup> *Journal of American Medical Association*, March 18, 1899, pp. 617, 618.



will contain evidence that one important factor in the spread of the disease was allowing flies to have access to the discharges from the bowels and bladders of infected persons, and the transference of the specific germs of the disease from those discharges to the food of the soldiers by the feet of flies.<sup>1</sup>

Early in the war Surgeon-General Sternberg called the attention of the surgeons in the field to the importance of guarding against this source of danger.<sup>2</sup>

That typhoid fever may be spread in that manner has also been claimed to have been maintained by bacteriological experiment.<sup>3</sup>

Experiences in Michigan have indicated that any camp, whether of soldiers, of lumbermen, or a camp-meeting, is liable to an outbreak of typhoid fever. The reason for this has not heretofore been plain, because no person actually sick with typhoid fever is likely to go to such a camp.

Three facts conjoined may now supply the explanation and indicate the proper preventive measures :

1. Camps are usually occupied in the season of warm weather, when flies are numerous.

2. The urine from some convalescents from typhoid fever contains an abundance of the specific germs of the disease.

3. Cystitis has been known to exist in a person for three years, during which time the urine contained the specific germs of typhoid fever.<sup>4</sup>

## PURIFICATION OF FLOWING WATER. SEDIMENTATION IN RESERVOIRS.

The old idea that a sewage-polluted stream purifies itself in flowing a few miles is not held by modern sanitarians, yet it still stands in the way of progressive action. It was at first based upon the hypothesis that the disease-producing agents in the sewage were chemical compounds susceptible of easy destruction by oxidization by free exposure to the atmosphere. At the time the idea was evolved the specific bacteriological causes of diseases were not known. At the present time the disease most commonly attributed to sewage-polluted water is typhoid fever, the specific cause of which is known to be not immediately destroyed by exposure in water the surface of which is in contact with the atmosphere.

“Taking all of the above facts into consideration, it appears to me

<sup>1</sup> Journal of American Medical Association, June 10, 1899, p. 1292.

<sup>2</sup> Ibid., May 7, 1898, p. 1133.

<sup>3</sup> M. A. Veeder. Medical Record, September 17, 1898.

<sup>4</sup> British Medical Journal, January 14, 1899, pp. 78, 79.

that the removal of impurities from rivers is more of a *biological than a chemical question*; and that in all discussions of the subject it is more important to consider the action of minute animals and plants, which may be looked upon as being indirectly most powerful chemical agents.”<sup>1</sup>

“The legitimate conclusion would seem to be that the minute forms of animal life are powerful agents in the self-purification of sewage-polluted waters; but the conclusion which has been drawn, that, therefore, sewage-polluted streams are, after a few miles flow, fitted through the action of such and other natural agencies for drinking, is wholly unjustified by the present state of knowledge of the subject as a whole.

“Along with our knowledge of the purifying action of the minute animals and plants has grown up a more definite knowledge of the causation of typhoid fever, cholera, and the other water-borne communicable diseases; and before it can be positively affirmed that a sewage-polluted stream is safe for drinking after a few miles flow, it must be shown so definitely as to be beyond question, by those whose special studies have fitted them for intelligent judgment, that the purifying agencies have practically eliminated the germs of the water-borne communicable diseases. Until such showing is clearly made, the proposition that crude sewage ought not to be turned into running streams, ponds, lakes, or other bodies of water, which either are or may be the sources of water-supplies, must be considered as holding good.”<sup>2</sup>

A good authority on this subject has recently said: “It has also gradually become plain that sedimentation and the destruction of micro-organisms by various agencies are more completely effected in standing than in moving water; so that modern sanitary science has reversed the tenet of thirty years ago, and now unhesitatingly affirms that it is quiet water rather than running water that ‘purifies itself.’ As a corollary of this doctrine, which is supported by an overwhelming mass of evidence, it follows, as a matter of course, that those cities and towns which, trusting in the earlier teaching, unwisely introduced systems of supply yielding water drawn, unpurified, directly from swiftly-running streams are now finding themselves in an unfortunate predicament; for in many of them it has been discovered that typhoid fever and kindred diseases are alarmingly abundant, and the conclusion is natural—inevitable, even—that in all probability the excess of typhoid fever from which many of them suffer is due to their use of unpurified, sewage-polluted river water.”<sup>3</sup>

<sup>1</sup> Sewage Disposal in the United States. By Geo. W. Rafter, M.A.S.C.E., and M. N. Baker, Ph.B., p. 79.

<sup>2</sup> Sewage Disposal in the United States. Rafter and Baker, p. 89.

<sup>3</sup> Prof. William T. Sedgwick, Lecturer on Sanitary Science, Massachusetts Institute of Technology; Report upon the Sources of Typhoid Fever in Pittsburg, Pa., p. 17; Report of Filtration Commission, Pittsburg, Pa., January, 1899.

"The time element is also important because there is reason to believe that the germs of typhoid fever do not ordinarily multiply in natural waters, at least in northern latitudes, but, instead, gradually die out."<sup>1</sup>

The time element is important, also, to permit of the purification of quiet waters by sedimentation.

### CEREBRO-SPINAL MENINGITIS.

The epidemic of this disease in the spring of 1899 has caused new interest in its etiology, but until its etiology is reasonably well understood its restriction and prevention must wait.

In a paper read before the Upper Peninsular Medical Society, at Calumet, Michigan, July 7, 1899, the writer of this article presented tables and diagrams proving that in Michigan epidemic meningitis occurs when those conditions which in ordinary years are coincident with the greatest prevalence of the diseases of the air-passages are intensified—the principal conditions being atmospheric cold and ozone—that the epidemic is most general in those parts of the State in which the cold and ozone are most pronounced; that in non-epidemic years there are two seasons of increased prevalence of what is reported as meningitis—one, as in epidemic years, following the greatest prevalence of the diseases of the air-passages, in the spring; the other in August, coincident with the greatest prevalence of intestinal diseases.

"The diagrams and other evidences put before this meeting seem to prove that epidemic meningitis in Michigan occurs in the spring, and is dependent upon influenza, pneumonia, tuberculosis, and the other germ-diseases which usually enter the body by way of the air-passages during and following the exposure to cold, dry, ozonized atmosphere, or it is caused by germs which are effective under conditions similar to those which favor the spread of those diseases.

"It seems also to be proved that, excluding those years in which meningitis was epidemic and unusually prevalent, the disease usually followed, and may be believed to have been in some way dependent upon, enteritis and the diarrhoeal diseases following the hot weather in summer. Whether or not the meningitis so generally prevalent in August is caused by the diplococcus intracellularis I have no certain knowledge, but I hope bacteriologists will take early opportunities to learn. Whether caused by that germ or by the same micro-organisms which cause the enteritis—such organisms as the streptococcus and bacillus coli—I believe that the summer meningitis, as well as the myelitis, will be prevented whenever the diarrhoeal diseases of summer are prevented, and that they

<sup>1</sup> Report of Filtration Commission, Pittsburg, Pa., January, 1899, page 18.

will be prevented through asepsis of foods and drinks, and especially lessened by the use of sterilized milk."

In that paper, also, was a plea for the destruction or disinfection of all sputa and all discharges from the nose, in the hope that meningitis of all forms, as well as the other diseases which enter by way of the nose and mouth in cold weather, and possibly also some of those which prevail in warm weather, may thus be restricted.

### **GENERAL PRINCIPLES OF ACTION IN PUBLIC HYGIENE.**

Of even greater importance than any single disease or cause of sickness or death are those general principles of action useful for the restriction or prevention of all diseases ; such, for instance, as that principle of action evolved in the United States about a quarter of a century ago, according to which a continuous "Campaign of Education" is maintained by a State Board of Health, by means of compulsory notification to local health officers by householders and physicians of every case of a dangerous communicable disease and prompt report of every outbreak to the State Board of Health, which is responded to by the office of the State Board by sending to the infected locality brief printed instructions how to restrict the particular disease there present, with a request that the local health officer distribute the leaflets of instructions to the neighbors of the infected and placarded premises, thus placing in the hands of persons interested, because threatened, information which under other circumstances would receive no attention.

During the past year no very marked extension over new territory of this principle has come to my notice, yet gradually such extension occurs, and in States which have long acted on this principle diseases not formerly dealt with have been included among those required to be reported, the conditions studied, and the persons most exposed instructed. An instance of this in the State of Michigan is the disease popularly known as consumption. A new law having been enforced, all deaths are required to be reported to the Secretary of State within four days after the close of each month. If a search through the reports reveals a death from a dangerous communicable disease, not previously reported to the office of the State Board of Health as having been sick with that disease, a polite circular is sent to the physician who signed the certificate of the cause of death, stating that as the case has not been reported, it is thought possible that the report may not have been sent to the local health officer ; therefore, a blank report is sent for use in case it has not previously been reported. The law requires a report, under penalty of forfeiture. Only the name, age, sex, and residence of the patient is

required to be promptly reported by the physician, but later the local health officer is asked to learn all possible facts likely to prove useful for studying the modes of spreading and the causation of the disease. During the past year in Michigan this system for gaining a knowledge of the disease, and for distributing to persons who cough, and their friends, brief instructions for lessening the risk of spreading the disease, has been extended to consumption, and already valuable information has been gained.

**The Extent of the Sickness and Mortality from Consumption Lessened by this Method.** The system has not yet been in operation long enough to supply information of the total number of cases in the State of tubercular disease or the number having well-developed lung tuberculosis. Indeed, there is not yet a State in the Union for which this information can be correctly stated. One method of attempting to gain this information indirectly is in operation in Michigan; the local health officer is asked to report, relative to each consumptive who dies, the duration of the disease with a view of multiplying the annual total number of deaths by the average duration of the disease, thus gaining an idea of the number living. The deaths have been about three thousand per year; therefore, there must have been in each year about that number of persons in the State who contracted the disease.

Applying this reasoning to the United States, the annual average deaths from consumption having been estimated at the time of the last census as about 140,000, about that number of new cases must occur in each year.

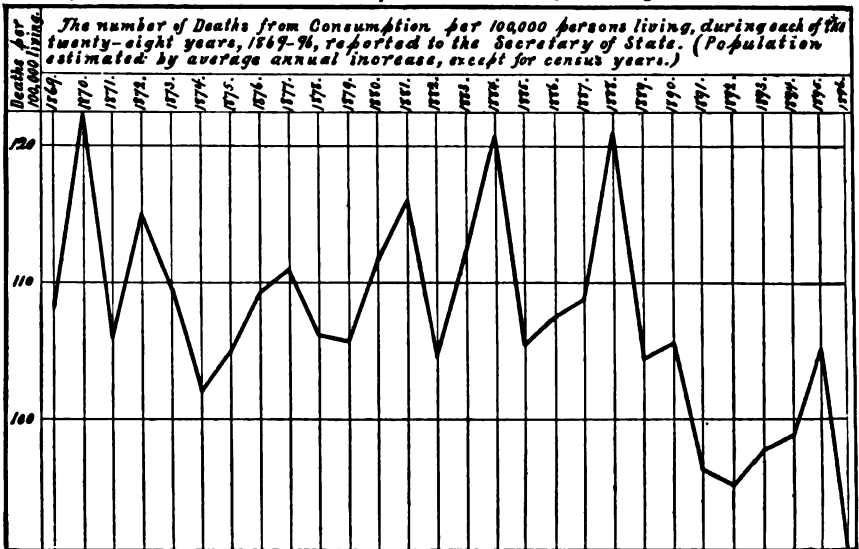
Inasmuch as a majority of the persons who die of consumption are at ages when, except for this disease, they should be in the prime of life (recent statistics in Michigan prove that over 50 per cent. of all the decedents from consumption are between the ages of fifteen and forty), the knowledge that in each year 140,000 persons will contract this dreadful disease should prompt the Congress of the United States to listen to the long-continued and urgent plea of physicians and sanitarians that the United States Government should establish and maintain a "Campaign of Education" by a national board of health, which should cause a lessening of such a fearful drain upon the life and health of its people.

**The Utility of a System of Sanitary Education.** An indication of what can probably be done by such a system of education is supplied by the results recently observed in Michigan, where such a system was vigorously commenced in 1891 and has been continued since then. Fig. 51 exhibits the deaths from consumption per 100,000 inhabitants, reported to the Secretary of State for each year before and since 1891; and although not all deaths were reported, the system of reporting was the same in all the years embraced in that diagram. It is plain that pre-

vious to 1891 the deaths reported had never been less than 100 per 100,000 inhabitants, and that since 1891 they have not exceeded that number, except in one year, and for that year the deaths reported were not as many as the average of preceding years. Since 1891 the deaths reported average 11 per cent. less in each year than they did previous to 1891, in which year the State Board of Health sent out thousands of its leaflets—to every physician, health official, minister, and newspaper, many of which published it entire, and many others in part.

FIG. 51.

*Reported Deaths from Consumption in Michigan, 28 years, 1869-96.*



Since 1897 a new law results in the reporting of nearly every death which occurs, and during the past year the system of education has been extended by reason of the deaths being promptly reported; it is confidently expected, therefore, that the statistics will soon show a still greater decrease in the mortality rates from consumption. But in the 11 per cent. annual reduction in the mortality enough has already been shown to prove to any State which has not yet adopted the system, or to the Congress of the United States, that the system is practicable and successful.

### **AIR-BORNE AND WATER-BORNE DISEASES.**

The Health Department of Chicago has recently entered upon an interesting study: "During the first four months of the current year an unusually great disparity between the number of deaths from what are here roughly grouped as the 'air-borne' diseases and from those simi-

larly grouped as the 'water-borne' diseases attracted the attention of the department and led to such a study of possible causes as time and opportunity have since afforded. . . . The 'air-borne' diseases include bronchitis, diphtheria, influenza, measles, pneumonia, scarlet fever, and whooping-cough. The 'water-borne' group includes cholera morbus, diarrhœa, dysentery, enteritis, gastro-enteritis, and typhoid fever."

It is not claimed that the diseases are all correctly classified as yet, and it may be found that they need rearranging, especially as regards some of the "water-borne" group; but the classification and study should lead to a distinct advance.

The diagrams in this report exhibit the relations of the air-borne diseases to atmospheric temperature and other atmospheric conditions, and the relations of the water-borne diseases to the condition of the city water-supplies; and although, as yet, they embrace too short periods (weeks) and too few observations, and include too many factors to make it possible to study them easily, yet when the data shall have been arranged by months, so that the accidental inequalities of the several weeks shall be divided by four and the results exhibited by full years, so as to give complete cycles, valuable information should be gained, especially if each meteorological or other condition is separately studied with each group of diseases.





# PRACTICAL THERAPEUTIC REFERENDUM.

By E. Q. THORNTON, M.D.

**Abortion.** The treatment of this condition may be conveniently considered under four headings: (1) Prophylactic treatment, instituted at the beginning of pregnancy to prevent the onset of symptoms in women who have previously aborted; (2) treatment of threatened abortion; (3) treatment of inevitable abortion; (4) treatment of incomplete abortion. The treatment of the last two conditions has been fully considered on pp. 335 and 336, vol. iii. It is pointed out in the article of Dr. Norris that the usual diseases which cause abortion are syphilis, nephritis, valvular affections of the heart, and acute infectious diseases in which pyrexia is a prominent symptom. The following prescription may, therefore, be used in syphilitic cases:

R.—Hydrargyri iodidi flavi . . . . . gr. xij.  
 Sacchari lactis . . . . . q. s.  
 Alcohol . . . . . q. s.

Misce et fiant tabellæ No. 1.

Sig.—One tablet three times a day.

The above to be employed from the beginning to the ending of pregnancy, the number of tablets being increased or decreased as required. In malignant and urgent cases, in conjunction with mercury by the mouth, it may be given by inunction or hypodermatically until the disease comes under control. The oleate of mercury is probably the most agreeable mercurial for external use and gray oil for hypodermatic use:

R.—Oleati hydrargyri . . . . . 3j.

Sig.—About one to two drachms to be employed by inunction each day.

R.—Olei hydrargyri (gray oil) . . . . . f 3 ijss.  
 Olive oil (sterilized) . . . . . f 3 vss.—M.

Sig.—Two to three minims are to be injected deeply into subscapular or gluteal region every second or third day until slight tenderness of gums occurs; then administer the drug every fourth, sixth, or tenth day, to keep patient under the influence of mercury.

The hypodermatic injections should be discontinued as soon as marked manifestations of syphilis disappear. In patients who have previously undergone a thorough course of treatment by mercury, potassium iodide will often be found to give better results.

R.—Potassii iodidi . . . . . ʒj.  
 Aquæ bullientis . . . . . q. s. ad. fʒj.—M.

Sig.—Five drops in a tablespoonful of essence of pepsin after each meal, gradually increased until symptoms yield or tolerance of drug is established.

In cases of nephritis with scanty urine and high arterial tension, nitroglycerin in doses of about  $\frac{1}{100}$  grain three or four times a day is our most valuable remedy. It may be administered either in solution or tablet triturations :

R.—Spiriti glonoini . . . . . fʒiv.

Sig.—One drop in water three times a day.

R.—Spiriti glonoini . . . . . gtt. l.  
 Sacchari lactis . . . . . q. s.  
 Alcohol . . . . . q. s.

Misce et fiant tabellæ No. l.

Sig.—One tablet three times a day.

In cases of nephritis with arterial relaxation, feeble heart, renal congestion, symphorol (sodium sulfocaffeate) is valuable :

R.—Symphorolis . . . . . ʒiv.

Fiant tabellæ No. xxiv.

Sig.—One tablet three times a day.

For the control of uterine bleeding in threatened abortion, the following remedy has been suggested :

R.—Hydrastinæ hydrochloratis . . . . . gr. iv.  
 Pepsini saccharati . . . . . ʒj.

Misce et fiant chartulæ No. xvi.

Sig.—One powder every two hours.

**Acromegaly.** Potassium iodide and extract of the pituitary body have been employed as curative agents. The coal-tar analgesics are used to relieve the annoying headache, and phenacetine in doses of 5 to 10 grains has been found valuable. The extract of pituitary body is usually ordered in capsules, as follows :

R.—Opohypophysini (Merck) . . . . . gr. xxv.

Pone in capsulas No. l.

Sig.—One to two capsules three times a day.

**Addison's Disease.** The results of treatment of this disease by the administration of the dried extract of suprarenal gland and also the fresh gland are somewhat contradictory. Suckling reports (vol. ii. p. 310) a case cured after treatment extending over a period of one year, the daily dose of the extract being increased from 10 grains to 200 grains. Carmont advises against the use of the extract by hypodermatic injections, a patient to whom he administered the remedy having died

in twenty-four hours after the injection. The extract is best given in tablet form :

R.—Extracti glandulæ suprarenalæ . . . . . 3iv.

Fiant tabellæ compressæ No. xlviii.

Sig.—One tablet twice daily, to be increased.

This treatment should be supplemented by the administration of strychnine, arsenic, iron, or quinine, together with rest, fresh air, inhalations of oxygen, and carefully regulated diet.

**Anæmia.** Treatment must be directed not only to increasing the number and quality of the corpuscles, but to the removal of the cause. As a result of experiments, Brown (vol. i. p. 304) believes that, unless combined with quinine, arsenic is of little value in the treatment of post-malarial anæmia. Koplik (vol. i. p. 182) calls attention to the fact that desiccated thyroid extract, in combination with iron, is of value in some cases of anæmia, and records a case of hydræmic anæmia with slight enlargement of the thyroid in which it proved of benefit. The following would be a suitable prescription for a child several years of age :

R.—Extracti thyreoidi desic. . . . . gr. xxiv.  
 Ferratini . . . . . gr. xxiv.  
 Sacchari . . . . . 3ij.  
 Theobromatis . . . . . 3ij.

Misce et fiant tabellæ compressæ No. xxiv.

Sig.—One to two tablets three times a day.

T. Panzer (vol. ii. p. 275) has employed iron somatose with benefit in chlorosis and secondary anæmia. The advantages claimed for the preparation are that it is tasteless, does not disorder digestion, constipate, nor darken the teeth :

R.—Ferri somatosi . . . . . 3ij.

Fiant in chartulæ No. xxiv.

Sig.—One powder in half a glass of warm milk after meals.

In leukæmia arsenic still appears to be the most valuable agent, but a number of reporters have advocated administering it in conjunction with red bone marrow. The arsenic is best given in the form of the solution of arsenite of potassium, in doses of as large quantities as can be tolerated. About two or three ounces of bone marrow, taken from the bones after boiling, should be administered daily. Dried red bone marrow may be prescribed as follows :

R.—Medullæ assii rubri sicc. pulv. . . . . 3iv.

Fiant in chartulæ No. xxiv.

Sig.—One powder three times a day.

The appearance of indican in the urine of a patient with pernicious anæmia indicates a process of internal putrefaction, and calls for calomel, salol, or other intestinal antiseptics (Grawitz, vol. ii. p. 284) :

R.—Saloli . . . . . ʒij.

Fiant in chartulæ No. xii.

Sig.—One powder two hours after meals.

**Aneurism.** Lancereaux and Huchard (vol. iii. p. 122) have reported upon the value of subcutaneous injections of gelatin in the treatment of sacculated aneurism, while Bornet, Barth, and Deguy (vol. iii. pp. 122 and 123) have called attention to the dangers and drawbacks in this method of treatment. A working formula is given below :

R.—White gelatin . . . . . ʒv.  
Sodium chloride . . . . . gr. clv.  
Distilled water . . . . . Oij.—ʒj.

Dissolve by the aid of heat and thoroughly sterilize.

Inject 50 c.c. (1½ ounce) deeply into the tissues of buttock or loin, and place the patient absolutely at rest. The injection is to be repeated at intervals of about eight days. The same formula has been employed in various forms of hemorrhage.

**Angiocholitis.** Toluylenediamine in 1 grain doses, taken twice a day, is favorably spoken of by Willoughby (vol. iv. p. 80) :

R.—Toluylenediaminæ . . . . . gr. xii.

Pone in capsulas No. xij.

Sig.—One capsule twice daily.

**Arterio-sclerosis.** Vierordt is a firm believer in the value of iodine (vol. iii. p. 125), particularly in coronary angina, while L. von Schrötter takes an opposite view. The iodine may be employed in the form of potassium iodide, a saturated solution being ordered as follows :

R.—Potassii iodidi . . . . . ʒj.  
Aque bullientis . . . . . q. s. ad. f ʒj.—M.

Sig.—Five drops in milk after meals, increased until symptoms yield or until iodism appears, when the remedy should be temporarily discontinued or the dose reduced.

In the presence of inflammation of the kidneys the iodides should be employed cautiously. A. E. Marshall thinks well of a combination of digitalis and nitroglycerin. This is particularly suitable in cases where the heart is weak and the arterial tension high, and may be administered as follows :

R.—Pulv. digitalis . . . . . gr. xxiv.  
Glonoini . . . . . gr. ʒ.

Misce et fiant in pilulæ No. xxiv.

Sig.—One pill every eight hours.

In advanced stages, with stiffened arteries and cardiac dilatation, erythrol tetranitrate (vol. iii. p. 125) may be given in doses of about ½ grain every six hours, administered either in alcoholic solution or in

tablets, but it must not be triturated, as it is explosive upon percussion. This substance acts as a vasodilator :

R.—Erythrolis tetranitratiss . . . . . gr. xxv.  
 Sacchari lactis . . . . . gr. lx.  
 Alcohol . . . . . q. s.

Misce et fiant tabellæ No. 1.

Sig.—One tablet every six hours.

Lancereaux and Paulesco (vol. iii. p. 126) have recommended iodothyrim in arterio-fibrosis in rheumatic and gouty subjects. The initial dose of 6 grains a day may be increased to a daily dose of 45 grains :

R.—Iodothyrim . . . . . ʒij.

Fiant tabellæ compressæ, No. 1.

Sig.—One tablet three times a day, to be increased.

**Ascites.** H. Schlesinger (vol. iv. p. 89) has highly recommended urea in daily doses of 300 grains as a diuretic in cirrhosis of the liver :

R.—Urea . . . . . ʒvj.

Fiant in chartulæ No. xxx.

Sig.—A powder in a full glass of water three times a day.

Apocynum has again come into more general use as an active diuretic. Inasmuch as little care seems to have been exercised in the collection of this drug, if used it should be obtained from a reliable source :

R.—Extracti apocyni fluidi . . . . . fʒj.

Sig.—Five to ten drops in water three times a day.

**Asthma.** Among the more recent remedial agents recommended for the relief of this affection are suprarenal extract (Swain, vol. iii. p. 67), orthoform (Lichtwitz, vol. iii. p. 69), and oxycamphor (R. Jacobson, vol. iii. p. 69). Suprarenal extract is best given in 5-grain tablets, but is also useful in solution for application to engorged nasal mucous membranes :

R.—Extracti suprarenalæ hæmostatici . . . . . ʒj.  
 Aquæ destillatæ . . . . . fʒij.—M.

Sig.—Instill a few drops into each nostril several times a day.

Orthoform is best given in 10-grain powders by insufflation twice daily, while the oxycamphor is ordered in 50 per cent. alcoholic solution in doses of 10 to 30 minims in aromatic elixir or wine :

R.—Orthoform . . . . . ʒij.

Fiant in chartulæ No. xij.

Sig.—One powder used by insufflation once or twice daily.

R.—Oxycamphoræ (50 per cent. solution) . . . . . fʒiv  
 Elixiris aromatici . . . . . q. s. ad. fʒij.—M.

Sig.—Teaspoonful in wineglassful of water twice or thrice daily.

Oxycamphor is said to relieve dyspnœa like morphine, but without the unpleasant after-effects.

**Blennorrhœa of Lachrymal Sac.** Pergens, Walter, and Wicherkiewicz (vol. ii. p. 433) employ 10 to 20 per cent. aqueous solutions of protargol, first irrigating with a solution of boric acid :

R. — Protargoli . . . . . gr. xlv. vel ʒj.  
Aqueæ destillatæ . . . . . f ʒj. — M.

Sig. — To be used by injection.

**Bronchitis.** Visanska refers (vol. iii. p. 60) to the employment of apomorphine in the treatment of acute bronchitis in children when the secretion is scanty and the cough hard and dry. He also thinks it a more valuable emetic than tartar emetic or ipecachuanha, especially where the excessive secretion so interferes with breathing as to render it desirable to produce emesis. James T. Whittaker's formulæ in acute bronchitis in children is as follows (vol. iii. p. 61) :

R. — Apomorphinæ hydrochloratis . . . . . gr. ss. vel gr. j.  
Acidi hydrochlorici diluti . . . . . gtt. x.  
Syrupi . . . . . f ʒss.  
Aqueæ menthæ piperitæ . . . . . q. s. ad. f ʒj. — M.

Sig. — Half to a teaspoonful every two hours.

**Calculi.** The reports of the use of piperazine to promote the solution and disintegration of calculi have been very favorable in several instances. If employed the drug should be continued over long periods of time. As piperazine undergoes chemical change when kept in solution for any length of time, the solution should be made fresh daily ; it is deliquescent, and, therefore, should not be dispensed in powders or tablets :

R. — Piperazinæ . . . . . ʒj.

Pone in phialas No. xl.

Sig. — The contents of a phial dissolved in a pint of water should be taken after each meal.

**Carbuncle.** Hypodermatic injections into and about the affected area (vol. iii. p. 196) of pure carbolic acid are recommended by Manley. In the earlier stages 1 to 3 drops is sufficient, but in the suppurative stage large quantities (15 to 30 drops) are required. The method is said by Manley not to be painful, and he has not observed any resulting toxic symptoms. Brewers' yeast three times a day has been highly recommended. Nuclein in doses of 15 to 45 grains three times a day has also been favorably spoken of :

R. — Nuclein . . . . . ʒiv.

Fiant tabellæ compressæ No. xxiv.

Sig. — One to two tablets three times a day.

**Cerebro-spinal Meningitis.** In epidemic cerebro-spinal meningitis Dr. Gustav Schirmer (*New Yorker Medicinische Monatschrift*, 1898, vol.

x., No. 11) has reported very favorable results obtained by the inunction of unguenti Crede, an ointment of soluble metallic silver :

R.—Unguenti Crede . . . . . 3 viij.

Sig.—Apply about an ounce daily by inunction.

The nasal mucous membrane is to be cleaned with antiseptic solution, hot applications are to be made to the spine to relieve pain, and 3 to 10 grains of trional given to induce sleep.

**Conjunctivitis.** Morax, Axenfeld, and Sweet (vol. ii. p. 372) lay stress upon the value of solutions of zinc sulphate when other treatment has been of no value in diplococcus conjunctivitis :

R.—Zinci sulphatis . . . . . gr. ij vel gr. ix.  
Aqueæ destillatæ . . . . . f 3j.—M.

Sig.—Use freely as eye wash.

Protargol, while of equal value with silver nitrate, is less irritating, and is now employed in the treatment of gonorrhœal conjunctivitis (vol. ii. p. 375). After cleansing with solution of boric acid, protargol solution, 5 to 20 per cent. in water, may be applied to the everted lid once a day, and a 1 per cent. solution instilled into the eye every two hours (vol. ii. pp. 375, 376, and 377) :

R.—Protargoli . . . . . gr. xxv vel gr. c.  
Aqueæ destillatæ . . . . . f 3j.—M.

Sig.—To be applied to everted lid with cotton swab once daily after cleansing with solution of boric acid.

R.—Protargoli . . . . . gr. ivss.  
Aqueæ destillatæ . . . . . f 3j.—M.

Sig.—Instill several drops into the eye every two hours.

**Corneal Ulcers.** As a means of rendering indistinct corneal ulcers (vol. ii. p. 381) visible a 2 per cent. alkaline solution of fluorescein in water may be instilled into the eye. The fluorescein gives a green color to that part of the cornea which is devoid of its epithelium, and the most minute ulcers are thereby made visible. Veasey (vol. ii. p. 381) prefers toluidin-blue solution (1 : 50) for the same purpose, as it is less irritating and hastens healing and diminishes the discharge :

R.—Fluorescein . . . . . gr. x.  
Sodii bicarbonatis . . . . . gr. x.  
Aqueæ destillatæ . . . . . f 3j.—M.

H. D. Burns (vol. ii. p. 383) recommends formol in 1 : 1000 solution. It should not be forgotten that formol is very painful, even in the strength of 1 : 2000 :

R.—Formaldehidi (40 per cent. solution) . . . . . gtt. j.  
Aqueæ destillatæ . . . . . f 3xviss.—M.

Sig.—Instill into the eye every hour or two, to be followed by hot bathing of the eye.

For mild cases Knapp (vol. ii. p. 383), under the influence of holocaine, sterilizes with tincture of iodine or silver nitrate.

It should be remembered that constitutional treatment is usually of the utmost importance in the treatment of corneal ulcers. Cassaripe ointment is favorably spoken of by Risley and Chandler (vol. ii. p. 383):

R.—Cassaripæ . . . . . gr. xij.  
 Petrolati . . . . . 3 ij.—M.

Sig.—Apply small quantity within lids two or three times a day.

**Cystitis.** In pyogenic infection of the bladder the internal administration of urotropin is considered our most efficient agent (vol. iv. p. 135). It is particularly applicable in cases with prostatic enlargement and inflammation:

R.—Urotropini . . . . . 3 iv.

Fiant cachetæ No. xxiv.

Sig.—One cachet three times a day, two hours after meals.

For irrigations for the chronically inflamed bladder and prostate, weak solutions of the following substances are recommended (vol. iv. p. 135): Potassium permanganate against colon bacilli; corrosive sublimate against the staphylococcus, streptococcus, typhoid, and tubercle bacilli; copper sulphate against the gonococcus; silver nitrate against all except the tubercle bacillus. The following is considered about the proper strength of solution to be employed:

R.—Potassii permanganatis . . . . . gr. viij.  
 Aquæ destillatæ . . . . . Oiv.—M.

Sig.—Warm gently and use by irrigation.

R.—Hydrargyri chloridi corrosivi . . . . . gr. iv.  
 Aquæ destillatæ . . . . . Oiv.—M.

Sig.—Warm gently and use by irrigation.

R.—Cupri sulphatis . . . . . gr. viij.  
 Aquæ destillatæ . . . . . Oiv.—M.

Sig.—Warm gently and use by irrigation.

R.—Argenti nitratis . . . . . gr. xvj.  
 Aquæ destillatæ . . . . . Oiv.—M.

Sig.—Warm gently and use by irrigation.

The French school favors the use of iodoform emulsion (vol. iv. p. 135) in the tubercular type.

**Diabetes Mellitus.** Among the more recent remedies employed are pancreatic extract, liver extract, ox-gall, thyroid extract, yeast, manganese dioxide, jambul, uranium nitrate, mercuric chloride, and methylene-blue; but none of these has supplanted or given such uniformly



good results as opium and its alkaloids, morphine and codeine, arsenic, and antipyrin (vol. i. pp. 130-134).

Pancreatic extract is believed by Lepine (vol. i. p. 131) to have a favorable effect upon glycolysis, but he insists that to have a favorable effect large quantities are necessary. It may be prescribed as follows :

R.—*Extracti pancreati* . . . . . 3j.

Fiant chartulæ No. viii.

Sig.—One powder with about equal bulk of sodium bicarbonate two hours after each meal.

Thyroid extract frequently appears to make the patient worse, although in some obese patients it seems to have been used with benefit ; it is best given in compressed tablets :

R.—*Extracti glandulæ thyreoidi* . . . . . 3ij.

Fiant tabellæ compressæ No. xxiv.

Sig.—One tablet after meals, increasing or decreasing the number according to the idiosyncrasies of the patient.

Liver extract has been employed clinically and experimentally. There have been some favorable reports, although they need confirmation :

R.—*Heparis siccati* . . . . . 3iv.

Fiant chartulæ No. xxiv.

Sig.—One powder in water three times a day.

Ox-gall has been employed in diabetes with insufficient excretion of bile with intestinal fermentation. It may be administered in doses of 5 to 20 grains three times a day, preferably several hours after meals :

R.—*Filis bovis purificati* . . . . . 3ij.

Fiant pilulæ No. xlviii.

Sig.—Two to four pills about two hours after each meal.

Yeast has been found of some value, although liable to disturb digestion. It is administered in tablespoonful doses after meals. A good substitute for yeast may be found in nuclein, which is to be taken in 5-grain doses, with about a teaspoonful of sodium bicarbonate, two hours after meals.

Manganese dioxide has been suggested by Lepine in treating the disease in obese subjects. It should be given in large doses :

R.—*Mangani dioxidi* . . . . . 3ij.

Fiant chartulæ No. xxiv.

Sig.—One powder after each meal.

Jambul is believed by Lepine to restrict glycogenesis :

R.—*Pulveris jamuni seminis* . . . . . 3ij.

Pone in capsulas No. xxiv.

Sig.—One capsule after meals, and increase.

Uranium nitrate, in doses of about one-sixth to one-fourth grain twice daily, has received the sanction of Bond and Daniels :

R.—Uranii nitratis . . . . . gr. iv.  
Syrupi saccharini . . . . . f ʒj.  
Aquæ . . . . . q. s. ad. f ʒiij.—M.

Sig.—Teaspoonful night and morning after food.

Mercuric chloride is believed (by A. Meyer) to exert a specific action upon a suppositious ptomain or bacterium, which he considers to be the cause of the disease :

R.—Hydrargyri chloridi corrosivi . . . . . gr. j.  
Aquæ destillatæ . . . . . f ʒiij.—M.

Sig.—Teaspoonful in a little water three times a day.

Methylene-blue has been used successfully in two cases by Estay :

R.—Tetramethylthyonine chloridi . . . . . ʒj.

Fiant tabellæ compressæ No. xxiv.

Sig.—One to two tablets after each meal. To be reduced in amount or withdrawn when the sclera develop a faint blue color.

The treatment of diabetic coma by saline transfusion has many adherents. Oliver, Besson, Roget, and Balxay report cases in which consciousness was restored after this method of treatment had been employed (vol. ii. pp. 334 and 335). Either of the following formulæ may be used :

R.—Sodii chloridi . . . . . ʒiijss.  
Aquæ bullientis . . . . . Oiv.—M.

Sig.—After allowing to cool to about blood heat slowly transfuse into a large vein, using two to four pints.

R.—Sodii bicarbonatis . . . . . ʒiij.  
Aquæ bullientis . . . . . Oiv.—M.

Sig.—Allow to cool to about blood heat and slowly transfuse two to four pints into a large vein.

**Diarrhoea, Infantile.** Lavage of the stomach is a most valuable means of controlling vomiting (vol. i. p. 124). Milk should be discontinued for a few days, and the child put upon barley- or rice-water, brandy, and beef juice. The intestinal antiseptics employed are salicylic acid, salol, salophen, resorcin, creosote, naphthalin, benzol naphthol, thymol, etc. Professional opinion is still divided as to the value of intestinal antiseptics, and it should not be forgotten that all coal-tar derivatives are distinctly depressant, and should be used cautiously. The following prescriptions may be used :

R.—Resorcini . . . . . gr. viii.  
Glycerini . . . . . f ʒj.  
Aquæ . . . . . q. s. ad. f ʒj.—M.

Sig.—Half to one teaspoonfu three times a day.

After the digestive canal has been freed of all products of fermentation and irritation, astringents such as tannigen, bismuth salicylate, bismuth subgallate, bismuth subnitrate, bismuth subcarbonate (vol. i. p. 126) may be administered singly or combined with intestinal antiseptics, as follows. Dott<sup>1</sup> recommends as an astringent the use of tannalbin :

R.—Tannalbin . . . . . 3j.  
Fiant chartulæ No. xx.  
Sig.—One powder every two hours.

R.—Tannigen . . . . . gr. xxiv. vel 3j.  
Fiant chartulæ No. xii.  
Sig.—One powder four times a day.

R.—Bismuthi subgallatis . . . . . gr. xxiv.  
Salopheni . . . . . gr. xij.  
Misce et fiant chartulæ No. xii.  
Sig.—One powder four times a day.

R.—Bismuthi salicylatis . . . . . gr. xxiv. vel 3j.  
Fiant chartulæ No. xii.  
Sig.—One powder four times a day.

R.—Bismuthi subnitratis . . . . . 3 iss.  
Acaciæ . . . . . 3 ij.  
Aquæ creosoti . . . . . f 3 ij.  
Aquæ . . . . . q. s. ad. f 3 j.—M.  
Sig.—Teaspoonful three or four times a day.

In conditions of exhaustion, especially when accompanied by the development of hydrocephaloid symptoms, the subcutaneous injections of saline solutions may be employed. The quantity to be used should be about four ounces three times a day (vol. i. p. 127).

The artificial serum of Hayem may be employed in the same quantities and in like manner, the formula of which is as follows :

R.—Sodii sulphatis . . . . . gr. v.  
Sodii chloridi . . . . . gr. iss.  
Aquæ destillatæ bullientis . . . . . f 3 ix.—M.

The dietetic treatment is fully considered on pages 332 and 333, vol. i.

**Diphtheria.** Although the mortality from this dreaded disease has been decidedly reduced by the use of diphtheritic antitoxin, the fact should not be lost sight of that the use of local and constitutional remedies is also of great value.

The immunizing dose of diphtheria is about 500 units, to be injected subcutaneously into the cellular tissues of the back, loin, abdominal wall, or thigh. For a child two years of age with laryngeal stenosis, and in other severe cases, 1500 to 2000 units are injected, and repeated

<sup>1</sup> Gazzetta degli Ospedali e delle Cliniche, 1898, No. 136, p. 1447.

in twenty-four hours if there is no improvement, and again at the same interval if required. In severe cases in children under two years of age 1000 units is considered the initial dose. The throat should be gargled or swabbed at frequent intervals with a solution of hydrogen peroxide or Loeffler's solution, applied on a pledget of cotton every three hours after wiping off the diphtheritic patch. Loeffler's solution is as follows :

R.—Mentholi . . . . .	3ijss.
Toluoli . . . . .	3ix.
Liquoris ferri chloridi . . . . .	f3j.
Alcohol absoluti . . . . .	f3ij.—M.

Sig.—Wipe off mucous membrane with dry absorbent cotton and apply the solution on pledget of cotton pressed against the diseased area for ten seconds every three hours.

When the disease attacks the nostrils a douche of a warm solution of chloride of sodium, three grains to the ounce of water, will be found useful for cleansing the cavity, thereby limiting secondary streptococcus infection.

The internal administration of whiskey, iron, and quinine is frequently of considerable value for the purpose of combating sepsis as a result of absorption. A valuable combination is given below :

R.—Tincturæ ferri chloridi . . . . .	f3j.
Quininæ hydrochloratis . . . . .	gr. xxiv.
Glycerini . . . . .	f3ij.
Aquæ . . . . .	q. s. ad. f3ij.—M.

Sig.—Teaspoonful in water every four hours (for child four years of age).

**Eczema.** Among the newer preparations employed is a 3 per cent. aqueous solution of methylene-blue in eczema of the ano-genital and groin region. This is recommended by Allen (vol. iii. p. 171) :

R.—Tetramethylthionini chloridi . . . . .	gr. xiv.
Aquæ . . . . .	f3iv.—M.

Sig.—Apply on absorbent cotton several times a day.

Hirschborn and Saalfeld (vol. iii. p. 173) recommend the employment of naphthalin in acute oozing eczema :

R.—Naphthalini . . . . .	gr. xv.
Petrolati . . . . .	3j.—M.

Sig.—Apply freely.

Hutschneker claims most satisfactory results in chronic cases by the application of 33½ per cent. of hydrargyrum vasogen (vol. iii. p. 173) :

R.—Hydrargyri vasogeni . . . . .	3ji.
Adipis lane hydrosi . . . . .	3vj.—M.

Sig.—Apply freely.

**Endocarditis.** Pain and inflammation may be relieved by the application of a series of small blisters along the course of the third, fourth,

fifth, and sixth intercostal nerves to the front and side (Caeton, vol. iii. p. 141). Only one blister, about one inch square, is applied at a time, and repeated daily. The thermo-cautery is to be preferred to cantharidal collodion in the production of the blisters.

Ulcerative endocarditis is usually a complication of septic processes, and is to be treated by remedies directed to preventing the development or neutralizing the effects of micro-organisms in the blood. Many newer agents claim attention, among which are salol, sodium sulphocarbonate, mercuric chloride, and antistaphylococcic and anstreptococcic serum (vol. iii. p. 139):

R.—Saloli . . . . . 3 iv.

Fiant chartulæ No. xxiv.

Sig.—One powder three times a day.

R.—Sodii sulphocarbonatis . . . . . 3 iv.

Aquæ gaultheriæ . . . . . q. s. ad. f 3 iij.—M.

Sig.—Two teaspoonfuls in water every four hours.

Moritz reports a cure in which he gave six daily injections of 5 c.c. (80 minims) of antistaphylococcic serum (vol. iii. p. 139). Contradictory results have been reported from the injections of antistreptococcic serum, the initial dose being 20 c.c. (f 5vj), repeated daily.

**Epilepsy.** Almost all of the newer hypnotics have been recommended in the treatment of epilepsy, and among those that appear to have been of most value, either as palliative or curative, is bromalin, which is a white crystalline powder or colorless scales, readily soluble in water, and given in doses of 30 to 60 grains. It is said not to cause bromism. Rohrmann (vol. iii. p. 275) considers it as palliative, but not curative, as the attacks return when it is discontinued.

R.—Bromalini . . . . . 3 iij vel 3 vi.

Syrupi aurantii . . . . . f 3 j.

Aquæ . . . . . q. s. ad. f 3 vj.—M.

Sig.—Tablespoonful in water after meals.

Bromopyrine, which occurs in white needle-shape crystals, soluble in alcohol and warm water, is said to combine the properties of bromides and antipyrine, and has been employed with asserted success in preventing the convulsive seizures. It may be administered in the same doses as antipyrine, either in powder or dissolved in wine. Rubidium and ammonium bromide, occurring in a yellowish-white powder, soluble in water, have been successfully employed in doses of 10 to 30 grains three times a day.

R.—Rubidii et ammonii bromidi . . . . . 3 ij vel 3 vj.

Syrupi acaciæ . . . . . f 3 ij.

Aquæ . . . . . q. s. ad. f 3 vj.—M.

Sig.—Tablespoonful in water after meals.

Antipyrine has been successfully employed by Dott in the treatment of menstrual epilepsy which had previously resisted treatment by bromide. Commencing a few days before the expected period, three or four times daily a powder containing five grains of antipyrine and two grains of sodium bicarbonate were administered. For the first time in five years this period passed without symptoms, and the continuance of this treatment at subsequent periods was successful. The surgical treatment is fully considered on p. 75, vol. i.

**Epithelioma.** Malignant growths should be treated surgically and excised when practicable. There are certain remedial agents which may be used to relieve pain, control symptoms, and remove fetor. Marsden's paste (vol. i. p. 30) has enjoyed considerable reputation for the removal of epithelioma of the skin. The formula is as follows :

R.—Acidi arsenosi . . . . . 3 ij.  
Mucilaginis acaciæ . . . . . 3 j.—M.

Sig.—Spread over growth and bind on with adhesive plaster ; after twenty-four hours remove and apply poultice to remove necrotic tissue.

Czerny's method (vol. i. p. 30) of treating epithelioma of the skin by the local use of arsenic solution may be employed.

The following lotion may be employed to control fetor where the growth can be reached :

R.—Formaldehydi (40 per cent. solution) . . . . . gtt. viij.  
Aqueæ hydrogeni dioxidii . . . . . ʒ xvj.—M.

Sig.—Use as wash every two hours.

**GASTRIC CARCINOMA.** To relieve pain of gastric cancer and assist digestion the following may be found useful :

R.—Ext. condurango fld. . . . . f ʒ ij.  
Acidi hydrochlor. dil. . . . . f ʒ ij.  
Syrupi acaciæ . . . . . q. s. ad. f ʒ iv.—M.

Sig.—Two teaspoonfuls in water before food.

The following prescription may be employed in gastric cancer, to relieve pain, control vomiting, and prevent putrefaction :

R.—Bismuthi subnitratii . . . . . ʒ iv.  
Acidi carbolicii . . . . . gtt. xvj.  
Aqueæ chloroformi . . . . . q. s. ad. ʒ viij.—M.

Sig.—Tablespoonful before food.

**Erysipelas.** Reports of the treatment of erysipelas by injections of antistreptococcic serum (vol. iii. p. 192) by Marmorek, Cotton, Robinson, Andre, and Bristow are most favorable as to its value in cases in which we have reason to suspect nasal origin. Allen (vol. iii. p. 193) applies an aqueous solution of ichthyol, 50 per cent. strength, to the anterior nares, and as far as possible to the posterior nares also ; to the diseased

cutaneous areas a 25 per cent. solution in collodion is employed. Metakresolanytol in 1 to 3 per cent. solution has been successfully used in five cases by Koelzer (vol. iii. p. 194).

R.—Metakresolanytol . . . . . ℥xvj.  
Alcohol . . . . . f ℥ij.—M.

Sig.—Paint the area for twenty or thirty minutes, and subsequently at intervals of two hours for ten minutes. If the disease is extensive only the edges are to be painted.

**Exophthalmic Goitre.** Potassium, sodium, or ammonium iodide are valuable to control the nervous symptoms, but strontium bromide, in doses of 10 to 30 grains for adults and 3 to 5 grains for children, is preferred by Gillespie.<sup>1</sup>

R.—Strontii bromidi . . . . . ℥iv.  
Aquæ destillatæ . . . . . q. s. f ℥ij.—M.

Sig.—One to three teaspoonfuls in a glass of sweetened water, to be drunk at meal-time.

R. Parker (vol. ii. p. 364) employed extract of thymus gland in four cases without obtaining any very positive results, although three of his patients showed some improvement.

R.—Thymi siccati pulv. . . . . 3ij.

Fiant tabellæ compressæ No. xxiv.

Sig.—One to two tablets three times a day.

To quiet the irritable heart, Whitla recommends the application of a weak continuous current (10 to 12 La Planchet's cells) to the cervical sympathetic. A large plate electrode attached to the negative pole should be placed upon the lower cervical spine, and the positive electrode moved about the skin in front of the sternomastoid muscles of each side. The occasional application of an ice-bag, or Leiter's coil, over the lower part of the neck and manubrium, with rest in bed, is considered valuable by Osler to relieve tachycardia. In the treatment of the anæmia, which is such a prominent symptom in this disease, arsenic, iron, and red bone-marrow are our most helpful agents. In cases with lowered arterial tension the extract of suprarenal gland, in moderate doses over a long period of time, has been employed with good effect.

R.—Extracti glandulæ suprarenalæ . . . . . 3iv.

Pone in capsulas No. i.

Sig.—One capsule after each meal.

Iodothyryn has been employed by Weiller (vol. ii. p. 364), who gave 250 milligrammes (4 grains), first once a day, then twice a day, and finally thrice a day.

<sup>1</sup> British Medical Journal, October 1, 1898.

R.—Iodothyri . . . . . gr. xl.

Fiant chartulæ No. xl.

Sig.—One powder daily, and gradually increase until three powders are taken daily.

**Galactagogues.** Drews and Joachim (vol. iii. p. 420) recommend the employment of somatose.

R.—Somatosi . . . . .  $\overline{3}$  iv.

Sig.—One to two tablespoonfuls in a glass of milk or cocoa several times a day.

**Gastralgia.** Hirschborn (vol. iv. p. 54) speaks favorably of pyramidon, a derivative of antipyrine, for relief of pain in pure gastralgia. It may be administered in doses of five to ten grains.

R.—Pyramidon . . . . . 3j.

Fiant chartulæ No. xii.

Sig.—One to three powders daily, as required.

**Gastric Dilatation.** Bandoïn (vol. iv. p. 42) recommends ammonium fluoride to control fermentation with food stagnation. The beginning dose of  $\frac{1}{4}$  grain may be increased to  $\frac{1}{2}$  grain three times a day.

R.—Ammonii fluoridi . . . . . gr. iv.

Aquæ destillatæ . . . . . f  $\overline{3}$  j.—M.

Sig.—Five drops in water three times a day, increased to thirty drops.

To control fermentation, Einhorn (vol. iv. p. 42) recommends 3 to 5 grains of resorcin.

R.—Resorcini . . . . . 3ij.

Glycerini . . . . . f  $\overline{3}$  iv.

Aquæ . . . . . q. s. ad. f  $\overline{3}$  iij.—M.

Sig.—Teaspoonful in water three times a day.

**Gastric Hyperæsthesia.** Among other drugs recommended by Dr. Stockton (vol. iv. p. 54) is orexin. It may be given in doses of 2 to 6 grains three times a day.

R.—Orexini . . . . . gr. xlvij.

Pone in capsulas No. xxiv.

Sig.—One capsule with a cup of beef juice three times a day.

**Gastric Indigestion.** To increase gastric secretion Fremont (vol. iv. p. 23) recommends among other bitter tonics cardui benedictine (blessed thistle herb), simaruba (mountain damson bark), and menyantes (buck-bean leaves). They may be administered in fluid extracts or in infusions.

R.—Extracti cardui benedicti fluidi . . . . . f  $\overline{3}$  ij.

Sig.—Thirty to sixty drops in water after meals.

R.—Simarubæ corticis . . . . . 3ss.

Aquæ bullientis . . . . . q. s. ad. f  $\overline{3}$  vj.

Misce et fiant infusum.

Sig.—Tablespoonful after meals.



R.—Menyanthes foliorum . . . . . ʒiv.  
 Aquæ bullientis . . . . . q. s. ad. f ʒvj.

Misce et fiant infusum.

Sig.—Tablespoonful after meals.

**Hay Fever.** Orthoform insufflation into the nares and extract of suprarenal gland, used either locally upon the nasal mucous membrane or taken internally, have been enthusiastically recommended. Litchwitz (vol. i. p. 427) has employed orthoform by insufflation in three cases. It is a white, voluminous, odorless, tasteless powder, permanent, non-hygroscopic, only slightly soluble in water, and produces a slight smarting sensation when applied to the mucous membrane.

R.—Orthoformi . . . . . ʒj.—M.

Sig.—About as much as can be held upon the thumb-nail is to be insufflated into each nostril night and morning.

Extract of suprarenal gland may be prescribed in 5 to 10 grain doses three times a day, given in powder, capsules, or compressed tablets.

R.—Extracti glandulæ suprarenalæ . . . . . ʒiv.

Fiant tabellæ compressæ No. xxiv.

Sig.—One tablet three times a day.

Irrigation of the nasal cavities with hydrozone is considered by Alexander Rixa (vol. iii. p. 70) as a valuable means of preventing the disease.

R.—Hydrozoni (30 vol.) . . . . . f ʒiv.—M.

Sig.—Two to six tablespoonfuls with half teaspoonful of sodium bicarbonate in twelve ounces of warm water as nasal douche twice or thrice daily.

**Hyperidrosis.** Unna speaks well of the following ointment (vol. iii. p. 153) to abolish the odor and diminish the hyperidrosis:

R.—Formaldehydi (40 per cent. solution) . . . . . f ʒij vel ʒiv.  
 Adipis lanæ hydrosi . . . . . f ʒj.—M.

Sig.—Apply once or twice daily in hyperidrosis of hands, feet, or axilla.

**Influenza.** In the early stages Butler Harris (vol. iii. p. 57) recommends salipyrin, which he claims relieves the pain and reduces fever without producing depression or collapse.

R.—Salipyrinæ . . . . . ʒii.

Pone in capsulas No. xxiv.

Sig.—One capsule every two or three hours.

**Intestinal Auto-intoxication.** Chinosol, actol, benzonaphtol, and soluble silver of Credé (vol. iv. p. 70) are among the more recent remedies employed in treating this condition.

R.—Chinosoli . . . . . ʒj.

Pone in capsulas No. xxiv.

Sig.—One capsule two hours after meals.

R.—Actolis . . . . . gr. vj.

Pone in capsulas No. xxiv.

Sig.—One capsule two hours after meals.

R.—Benzonaphtolis . . . . . 3j.

Pone in capsulas No. xxx.

Sig.—One to four capsules two hours after meals.

**Malaria.** Euchinin (or euquinine), which is the ethyl carbonate of quinine, has been recommended by St. George Gray, Mori, Sukhomlin, Zangri and Peratoner, Lewkowicz, and Goniev (vol. i. pp. 301, 302, and 303). While the dose is somewhat larger than quinine, it is devoid of taste, and therefore particularly well suited for administration to children. The daily dose for adults is from 15 to 45 grains.

R.—Euchinæ . . . . . 3ij.

Fiant chartulæ No. xxiv.

Sig.—A powder taken on the tongue six, four, and two hours before expected paroxysm.

After the paroxysms have been aborted it should be continued in smaller doses for about six days. Chinopyrin, a concentrated aqueous solution of quinine hydrochloride (50 per cent.), and antipyrine (33½ per cent.) have been recommended by Laveran and Gessard (vol. i. p. 304) for hypodermatic use.

A working formula is given below :

R.—Quininæ hydrochloratis . . . . .	gr. xxx.
Antipyrine . . . . .	gr. xx.
Aquæ destillatæ . . . . .	f3j.—M.

Ten minims represent about eight grains of quinine and four and a half grains of antipyrine. Although the injection of ten minims of the above has given rise to unpleasant results, Lewkowicz (vol. i. p. 304) has administered as much as fifteen minims to a boy eight years of age.

**Menopause.** The reports of employment of ovarian extract for relief of the nervous and congestive symptoms during natural or artificial menopause are somewhat contradictory, but the observations of F. Jayle (vol. ii. p. 156) are most complete. It may be given in daily doses of 2 to 7 grains and increased :

R.—Opoovariini . . . . . 3iv.

Fiant tabellæ No. c.

Sig.—One tablet three times a day, and increase.

**Motor Insufficiency of Stomach.** Küss and Penzoldt (vol. iv. pp. 47 and 48) recommend orexin. It may be given in doses of from 2 to 6 grains, preferably in wafers or capsules, and followed by a draught of beef-tea or cocoa to prevent gastric irritation.

R.—Orexini . . . . . gr. xlviii.

Pone in capsulas No. xxiv.

Sig.—One to three capsules once, twice, or thrice daily.

**Myoma Uteri.** Polk's experience with thyroid extract and Shober's with mammary extract (vol. ii. p. 248) would appear to justify their experimental use when operative interference is not urgent. Ovarine has also been used with asserted value in several cases.

R.—Extracti thyreodidi . . . . . 3 ij.

Pone in capsulas No. xxiv.

Sig.—One to four capsules three times a day.

R.—Extracti mammarum siccatarum . . . . . 3 iv.

Fiant tabellae No. xxiv.

Sig.—One to four capsules three times a day.

R.—Ooovariini . . . . . 3 ij.

Fiant tabellae No. xxiv.

Sig.—One to two capsules three times a day.

**Obesity.** Thyroglandin is a preparation of thyroid gland used by W. MacLennan (vol. ii. p. 351) in three cases. It was given in one-grain doses, three times a day, and rapidly increased until nine grains daily were administered. No unpleasant symptoms were noted in MacLennan's cases.

R.—Thyroglandin . . . . . gr. c.

Sacchari lactis . . . . . gr. c.

Misce et pone in capsulas No. c.

Sig.—One capsule three times a day and increase.

**Oxæna.** Among the more recent methods of treatment are by cupric electrolysis (vol. i. p. 421), injections of diphtheria antitoxin (vol. i. p. 424), and the local application of resorcin or ichthyol (vol. i. p. 426).

R.—Ichthyolis . . . . . 3 ij.

Aquæ destillatæ . . . . . f 3 vj.—M.

Sig.—Apply to nasal mucous membrane after cleansing with 2 per cent. aqueous solution of ichthyol.

**Phthisis.** The treatment by tuberculin, antituberculin, antitoxins, and serum is fully discussed in Dr. Ewart's article in vol. iii. p. 81.

Dr. Albert Mann (vol. iii. p. 91) reports two cases which showed improvement from the intravenous injection of aqueous solutions of 1 per cent. sodium cinnamate.

R.—Sodii cinnamatis . . . . . gr. v.

Sodii chloridi . . . . . gr. iij.

Aquæ destillatæ . . . . . f 3 j-3 ss.—M.

Sig.—One to two minims injected into median basilic or cephalic vein at intervals of forty-eight hours, or twice or thrice a week.

**COUGH.** Chaplin and Tuncliffe (vol. iii. p. 93) speak favorably of the value of guaiacolate of piperidine, and Wainwright (vol. iii. p. 93) of eosote (valerianate of creosote), and geosote (valerianate of guaiacol) to relieve irritable cough. The dose of piperidine guaiacolate is from 5 to 20 grains three times a day, and of eosote and geosote from 3 to 9 grains three times a day.

R.—Piperidinæ guaiacolatis . . . . . 3ij.

Pone in capsulas No. xxiv.

Sig.—One to four capsules three times a day.

R.—Creosoti valerianatis . . . . . 3j.

Pone in capsulas No. xx.

Sig.—One to three capsules three times a day.

R.—Guaiacoli valerianatis . . . . . 3j.

Pone in capsulas No. xx.

Sig.—One to three capsules three times a day.

Dreser, Floret, Manges, and Strube (vol. iii. p. 95) prefer heroin to morphine or codeine to quiet the irritative cough.

R.—Heroini . . . . . gr. j.  
Acidi acetici diluti . . . . . f 3ss.  
Syrupi acidi citrici . . . . . f 3j.  
Aquæ cinnamomi . . . . . q. s. ad. f 3ij.—M.

Sig.—One to two teaspoonfuls every two, three, or four hours.

Korte (vol. iii. p. 95) prefers dionin (ethylmorphine hydrochlorate) to other sedative for the purpose of quieting the cough and preventing night-sweats.

R.—Ethylmorphinæ hydrochloratis . . . . . gr. v.  
Syrupi acidi citrici . . . . . f 3iv.  
Aquæ . . . . . q. s. ad. f 3j.—M.

Sig.—Fifteen drops in water, as required, to control irritable cough.

Peronine is recommended by Mayor and West (vol. iii. p. 96) for the purpose of controlling the irritable cough.

R.—Peronini . . . . . gr. j.  
Aquæ . . . . . 3v.—M.

Sig.—One to two drops in a little water every two or three hours, or as required, to control cough.

**HÆMOPTYSIS.** Berthe (vol. iii. p. 97) seems to have obtained good results in tuberculosis with recurrent hemorrhages by administering hepatic extract; liver extract in doses of 5iii (12 grammes) by mouth or rectum, or 3v (150 grammes) of the freshly emulsified liver substance by rectum. The dried extract may be employed as follows:

R.—Heparis siccati . . . . . 3vj.

Fiant chartulæ No. xii.

Sig.—A powder in an ounce of water by mouth or rectum to control hemorrhage.

Gabrilowisch (vol. iii. p. 97) recommends fluid extract of *hydrastis canadensis* in 30 drop doses for recurrent hemorrhage.

**NIGHT-SWEATS.** Thallium acetate ( $1\frac{1}{2}$ -grain pills) is recommended by Combemale (vol. iii. p. 98) to control night-sweats.

R.—Thallium acetatis . . . . . gr. vj.  
Miccæ panis . . . . . gr. viij.—M.

Fiant in pilulæ No. iii.

Sig.—One pill an hour before the expected sweat

The remedy should not be given for more than four successive days, for although no toxic symptoms have been produced, complete loss of hair has resulted in several cases from its prolonged use. Thallium acetate is said to continue to exert its effects for eight or ten days.

Piperidine guaiacolate (vol. iii. p. 98), in doses of from 5 to 20 grains given an hour before the expected sweat, has been successfully employed to prevent night-sweats.

R.—Piperidinæ guaiacolatæ . . . . . ʒij.

Pone in capsulas No. xxiv.

Sig.—One to four capsules one to two hours before the expected sweat.

**Pneumonia.** Silver nitrate in daily doses of  $\frac{1}{4}$  grain to  $\frac{1}{2}$  grain has been employed by Caccianiga (vol. iii. p. 51) in acute pneumonia in children, and is said to hasten the crisis.

R.—Argenti nitratis . . . . . gr. j.  
Ext. glycyrrhizæ puri . . . . . gr. xl.

Misce et fiant in pilulæ No. xl.

Sig.—One pill every hour until ten pills have been taken each day.

The reports of the use of Pane's antipneumonic serum (vol. i. p. 388) are most flattering.

**Psoriasis.** Rille has had good results in obstinate cases from the hypodermatic use of sodium cacodylate (vol. iii. p. 179):

R.—Sodii cacodylatis . . . . . gr. l vel gr. c.  
Aquæ destillatæ . . . . . f ʒj.—M.

Sig.—Ten to fifteen minims subcutaneously once a day.

**Whooping-cough.** Among the more recent remedies recommended are saccharated extract of thymol, bromoform, and vapor of formalin (vol. iii. pp. 64 and 65).

R.—Thymoli . . . . . gr. iij.  
Elixiri aromatici . . . . . f ʒij.—M.

Sig.—Teaspoonful in water three times a day.

R.—Bromoformi . . . . . f ʒss.  
Syrupi lactucarii . . . . . f ʒj.  
Spiriti vini gallici . . . . . q. s. ad. f ʒij.

M.—(Shake well).

Sig.—Teaspoonful every four or six hours. For child of six years of age.

R.—Formalini . . . . . ℥xvj.  
 Aquæ . . . . . f℥iv.—M.

Sig.—To be used as spray in neighborhood of patient. Care should be taken not to get the spray in the eyes.

**Vomiting of Pregnancy.** Orexin and its salts have been warmly recommended by Frommel, Rech, and others (vol. iii. p. 330). It is soluble in water, but irritating to the gastric mucous membrane.

R.—Orexini . . . . . 3ss.

Pone in capsulas No. xii.

Sig.—One capsule three times a day, followed by a draught of tea or cocoa to prevent gastric irritation.

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